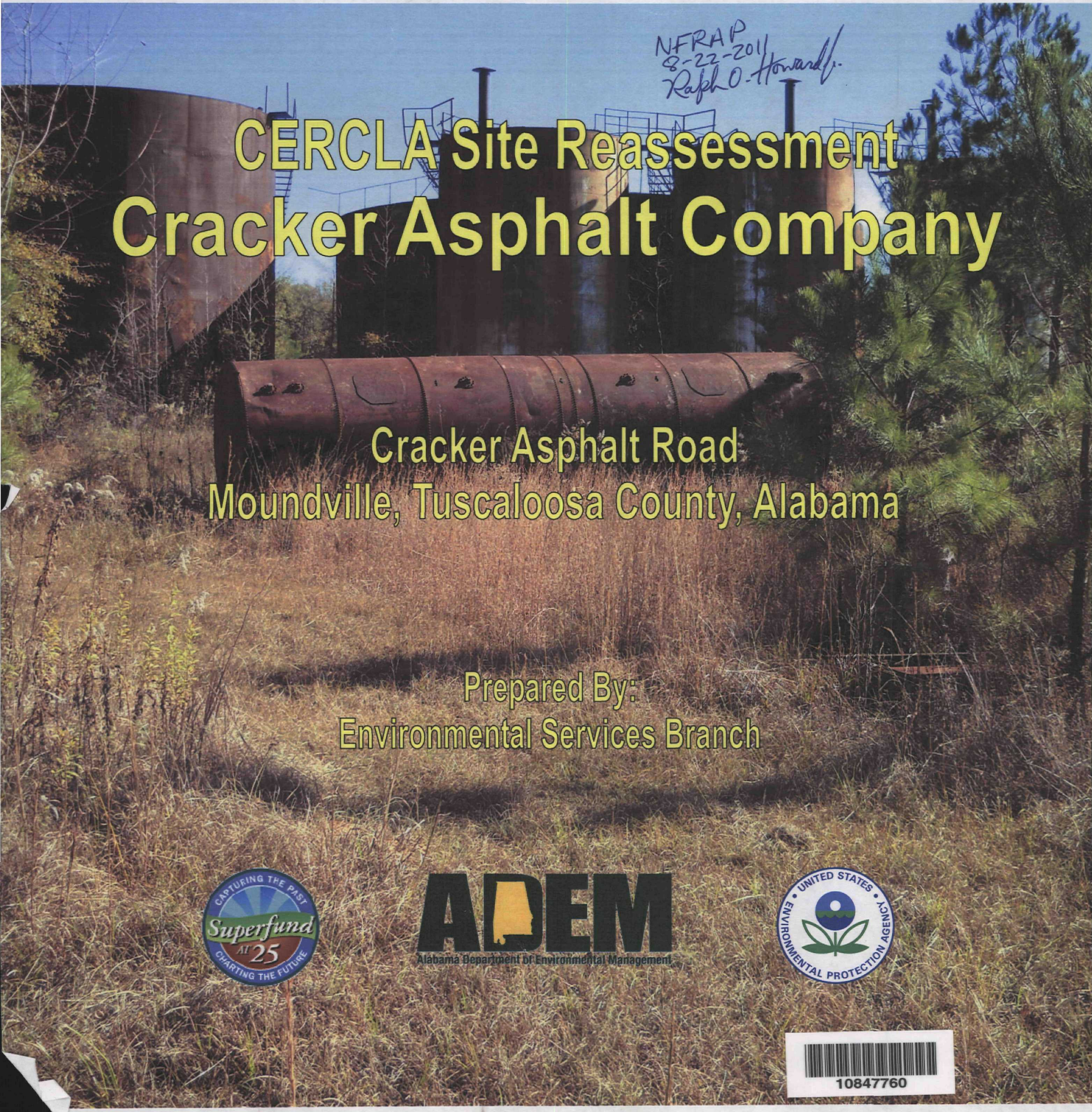
NFRAP
8-22-2011
Ralph O. Howard Jr.



CERCLA Site Reassessment
Cracker Asphalt Company

Cracker Asphalt Road
Moundville, Tuscaloosa County, Alabama

Prepared By:
Environmental Services Branch

Capturing the Past · Superfund at 25 · Charting the Future

ADEM
Alabama Department of Environmental Management

United States Environmental Protection Agency

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ROBERT J. BENTLEY
GOVERNOR

June 14, 2011

NFRAP
8-22-2011
Ralph O. Howard Jr.

Ralph O. Howard, Jr., P.G.
Remedial Project Manager,
US Environmental Protection Agency, Region 4
61 Forsyth Street SW
Atlanta, Georgia 30303

RE: Site Reassessment
Cracker Asphalt Company

Dear Mr. Howard:

In accordance with our current CERCLA grant work-plan, ADEM personnel performed a Site Reassessment of the Cracker Asphalt Company Site, Cracker Asphalt Road, Moundville, Tuscaloosa County, Alabama. The Site is the location of a former asphalt refining and storage business that went bankrupt in the late 1960s, leaving behind multiple large storage tanks containing bottoms or other byproducts. Groundwater contamination from BTEX and other constituents was detected in monitoring wells at the adjacent Southern Resins site. This contamination appears to have originated from a leaking storage tank (at the Cracker Asphalt Site) that was previously leased by Southern Resins for byproduct petroleum solvent storage. After several years of monitoring, the data indicated that groundwater contamination had been naturally attenuated; ADEM subsequently approved a request to discontinue monitoring. Despite the presence of several large tanks that contain asphalt bottoms and/or byproducts, the Site does not appear to pose an immediate threat to human health and the environment. The owner has been advised to retain an environmental consultant to assist with the assessment and removal of tank contents. At this time, the Site does not appear to warrant further action under CERCLA.

If you have any questions concerning this Site Reassessment, please contact Dylan C. Hendrix, at (334) 271-7987.

Sincerely,

Dave Davis

James L. Bryant, PE for
Chief, Environmental Services Branch

JLB/dch
Attachment:

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ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

CERCLA Reassessment
Cracker Asphalt Site
Tuscaloosa County, Alabama

1. INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), and a cooperative agreement between the United States Environmental Protection Agency (EPA) and the Alabama Department of Environmental Management (ADEM), a Reassessment was conducted at the Cracker Asphalt Company (CAC or the Site) located at Cracker Asphalt Road, Moundville, Tuscaloosa County, Alabama. The assessment was to collect information concerning conditions at the site sufficient to assess the threat posed to human health and the environment and determine the need for additional investigation under CERCLA. The investigation included a review of available file information, a comprehensive target survey, and off-site/on-site reconnaissance.

2. SITE DESCRIPTION AND OPERATIONAL HISTORY

2.1 Location

The Site is on Cracker Asphalt Road in Moundville, Tuscaloosa County, Alabama. The geographic coordinates of the site are 33°00'42.86" north latitude and 87°37'22.18" west longitude (Att 1). The facility is about 0.5 miles northeast of the Moundville Archaeological Park (Fig 1).

The climate of Tuscaloosa County is characterized as temperate with hot summers, mild winters, and precipitation during all months of the year. The average annual rainfall for Tuscaloosa, Alabama is 54.09 inches, with a 24-hour maximum of 6.44 inches. The 2-year, 24-hour rainfall for this region of Alabama is 4.0 inches. The average annual temperature is 64.0°F, with an average summer temperature of 80.6°F and average winter temperature of 46.7°F. (Ref 1, 2)

2.2 Site Description

The Site occupies 24 acres in an industrial area bound on the north by a mixed pine and hardwood forest, on the east by a methane well access road, on the south by railroad tracks, and on the west by the Alabama Biodiesel Corporation facility (formerly Southern Resins). There are no fences securing the facility except for the fence along the west side of the Site which separates the Alabama Biodiesel Corporation property from the Site. Thick vegetation and/or forested areas border most of the Site. The area is accessible to the public via Cracker Asphalt Road and the surrounding properties to the north and east. (Fig 1, Att 2)

Some changes to the Site have occurred since the SI report in 1995. Several large diesel tanks near the north end of the facility were removed prior to this reassessment, and evidence suggests that some asphalt tanks may have been removed as well. Discussions with the current operators at the Site revealed that the tanks were removed and sold as scrap metal. (Ref 3, Att 2)

2.3 Operational History and Waste Characteristics

According to the SI, the Site was purchased by Mr. Conrad Wesselhoeft in 1968 during a bankruptcy sale. It was previously owned by Cracker Asphalt Company which operated an asphalt refining and storage business. CAC left behind warehouses, shops, various types of petroleum and asphalt processing equipment, a cooling pond, a sediment pond, and multiple large above-ground storage tanks. After purchasing the property, Mr. Wesselhoeft began operating a metal fabrication business manufacturing custom tank heads. Mr. Wesselhoeft operated his metal fabrication business under the name of B&W Heads (Ref 3). In 2003, ownership of the site transferred to Mr. Wesselhoeft's daughter, Anne W. Smalley, who is the current operator of B&W Heads (Ref 4). The SI noted that Mr. Wesselhoeft had occasionally leased one of the large-capacity tanks to the adjacent Southern Resins Company for storage of by-product petroleum solvents; the leased tank was eventually removed from the area and sold as scrap metal (Ref 3). Several other tanks throughout the Site have also been removed and sold as scrap metal (Att 2).

The SI identified several possible sources of contamination suspected of originating from the site. These included a sediment pond, a cooling pond, the tank leased by Southern Resins Company, two asphalt skimmer trenches, and several large storage tanks that have not been used since Mr. Wesselhoeft purchased the site (Ref 3). During a recent site visit, it was discovered that many of the large capacity tanks on-site contained "bottoms" or other asphalt-related by-products. Areas of solidified tar or asphalt and stained soil were observed on the ground throughout the Site. (Att 2)

Since 1991, Southern Resins Company has been conducting semi-annual groundwater monitoring for multiple Constituents of Potential Concern (COPC) including benzene, styrene, toluene, xylene, naphthalene, dicyclopentadiene, and other aromatic compounds. Both ADEM and Eastman Resins (formerly Southern Resins) determined that groundwater contamination near the eastern edge of the property had originated from the petroleum solvent storage tank leased from Mr. Wesselhoeft. Data from Monitoring Well 11 (MW-11), located near the eastern edge of the Southern Resins property, supported this conclusion (Ref 5). Data from down-gradient monitoring wells MW-3, MW-4, MW-5D, and MW-11 indicated a decrease in contaminant concentrations over several years, and in 2006 Eastman Resins notified ADEM of its intent to discontinue groundwater monitoring (Ref 6). In 2008, ADEM approved this request in a letter to the current owners of Southern Resins property, Alabama Biodiesel Corporation (Ref 7). Earlier data indicated that concentrations of groundwater contaminants in the vicinity of MW-3, MW-4, and MW-5D had decreased below detection limits. Data from the final sampling event in 2006 shows that concentrations of contaminants in the vicinity of MW-11 have decreased due to natural attenuation but are above state and federal benchmarks for drinking water (Ref 6). Groundwater contamination in the vicinity of MW-11 did not appear to be migrating from the area as evidenced by the non-detect results from down-gradient monitoring wells (Ref 5). As previously noted, the suspected source (the storage tank leased from Mr. Wesselhoeft) of groundwater contamination in MW-11 was removed from the Site and sold as scrap metal (Att 2).

During the fall of 1985, samples were collected from contact seeps and springs along the banks of the Black Warrior River and Carthage Branch, a nearby tributary. Analyses indicated that seeps in these areas were contaminated with Volatile Organic Compounds (VOCs) including benzene, methylene chloride, styrene, xylene, toluene, cyclopentadiene, and other similar aromatic compounds. In July 2003, analyses of samples collected from the seeps found that concentrations of VOCs had fallen below detection limits. Eastman Resins notified ADEM that it would conduct additional monitoring at these seeps if trigger levels for COPCs were detected in monitoring wells

MW-3 and MW-4. At this time there appears to be no further sample data available for the groundwater springs and seeps along the Carthage Branch and the Black Warrior River. (Ref 5)

3. GROUNDWATER PATHWAY

3.1 Hydrogeologic Setting

No change. The geologic units that outcrop in Moundville and the surrounding area are of sedimentary origin and consist of gravel, sand, silt, and clay. At the site, alluvium and terrace deposits overlie the Gordo and Coker formations of the Tuscaloosa Group. (Ref 3)

3.2 Groundwater Targets

The only public water supplier in a 4-mile radius of the Site is Moundville Water Works (MWW), which operates one well within four miles.(Ref 8, Att 1). According to previous assessments, this well is screened in the Coker formation, which underlies the Gordo formation and terrace deposits (Ref 3). MWW operates a blended system that uses 100 percent groundwater from two active wells, serving a population of 4,200. The Hale County Water Authority purchases water from MWW on an emergency basis only and is not being evaluated as part of the system. The total number of individuals supplied by groundwater divided by the two active groundwater wells is about 2,100 individuals per well. (Ref 8, Att 1)

The well distribution in the 4-mile radius of the Site and the populations served by those wells are as follows: Wells in 0 - 0.25 mile of the site, 0; the population served is zero. Wells in 0.25 - 0.50 mile of the site, 0; the population served is zero. Wells in 0.50 - 1 mile of the site, 0; the population served is zero. Wells in 1 - 2 miles of the site, 0; the populations served is zero. Wells in 2 - 3 miles of the site, 0; the populations served is zero. Wells in 3 - 4 miles of the site, 1 the populations served is 2,100. The total population supplied by the wells in the 4-mile radius of the site is 2,100. (Att 1)

There are two wellhead protection areas for the MWW system in the 4-mile radius of the site. (Fig 2). Private water supply wells are expected in the 4-mile radius of the site due to the rural nature of the area. The SI documented residences operating private wells in the 4-mile radius of the Site, and it was noted that additional undocumented wells were also likely to be present in the area. (Ref 3)

3.3 Ground Water Conclusions

There are two MWW wellhead protection areas within four miles of the Site, and private water wells have been documented in the area as well. MWW operates only one public drinking water well in the 4-mile radius of the site and serves a population of 4,200. Despite evidence that the shallow terrace deposits and Gordo aquifers underlying the Site and adjacent property are contaminated, historical groundwater monitoring data suggest a consistent decrease in concentrations over the years. Additionally, the one public water supply well operated by MWW within four miles of the Site is screened in the Coker aquifer, which is segregated from the overlying shallow aquifers by upper units consisting of clay. Groundwater in the shallow terrace deposits underlying the Site also appears to flow toward the Black Warrior River and not in the direction of public water supply wells to the south. Multiple factors indicate that the potential threat to public wells is minimal; however, because there are known private wells in the area, additional surveys of nearby residences may be needed to determine if private drinking water supplies are at risk of contamination. The presence of tar and asphalt material in tanks and on the ground throughout the Site represents another potential threat to groundwater resources. Additional investigation of shallow groundwater at the Site may be warranted if private water wells are in close proximity to the area and if tar and asphalt material on the ground throughout the site are shown to contain leachable hazardous constituents.

4. SURFACE WATER PATHWAY

4.1 Hydrologic Setting

No change. Surface water exits the Site via several well-defined discharge points as well as many other less-defined points. One probable point of entry (PPE) is at a point on the Carthage Branch southwest of the Site. It appears that surface water draining into the sediment pond exits the western portion of the Site and enters the Carthage Branch. Another PPE is located near the northwest corner of the Site, the area with the lowest elevation, where surface water is discharged directly to the Black Warrior River. (Ref 3)

4.2 Surface Water Targets

There are no public water supply intakes along the 15-mile surface water pathway (Att 1). The Black Warrior River from the Oliver Lock and Dam to the Warrior Lock and Dam has a use classification of Fish and Wildlife (Ref 9). The Carthage Branch has no use classification and is assigned the general use classification of Fish and Wildlife.

The Black Warrior River traverses both Tuscaloosa County and Greene County along the 15-mile surface water pathway. Endangered and threatened aquatic species in both counties must be considered when evaluating the surface water pathway. The endangered/threatened species for Tuscaloosa County and Greene County are: Wood Stork, *Mycteria Americana* (endangered); Bald Eagle, *Haliaeetus leucocephalus* (protected under the Bald and Golden Eagle Protection Act); Flattened Musk Turtle, *Sternotherus depressus* (threatened); Southern Clubhsell Mussel, *Pleurobema decisum* (endangered); Dark Pigtoe Mussel, *Pleurobema furvum* (endangered); Ovate Clubshell Mussel, *Pleurobema perovatum* (endangered); Alabama Moccasinshell Mussel, *Medionidus acutissimus* (threatened); Inflated Heelsplitter Mussel, *Potamilus inflatus* (threatened); Fine-lined Pocketbook Mussel, *Hamiota altilis* (threatened); Orange-nacre Mucket Mussel, *Hamiota perovalis* (threatened); Heavy Pigtoe Mussel, *Pleurobema taitianum* (endangered); Stirrup Shell Mussel, *Quadrula stapes* (endangered); Mitchell's Satyr Butterfly, *Neonympha mitchellii mitchellii* (endangered), (Ref 10). Along the surface water pathway are 9.39 miles of wetland frontage (Fig 3).

The Black Warrior River at Bankhead Lock & Dam near Bessemer, Alabama has a mean annual flow rate of 6,443 cubic feet per second for Water Years 1929-2009. USGS discharge data for the Black Warrior River at Bankhead Lock & Dam are collected from gauging station 02462500, located at 33°27'30" north latitude, 87°21'15" west longitude. (Ref 11) The Site is outside of the 500-year floodplain (Fig 4).

4.3. Surface Water Conclusions

There are no public water supply intakes located along the 15-mile surface water pathway. The Site does not appear to represent a potential threat to public water supplies via the surface water pathway. There are 9.39 miles of wetland frontage along the surface water pathway, as well as several threatened and endangered species known to inhabit portions of the Black

Warrior River. Previous assessments concluded that contaminants were likely released to the surface water pathway by means of both overland drainage and groundwater to surface water discharge. Samples collected from seeps and springs along the south bank of the Black Warrior River and the east bank of the Carthage Branch indicated contaminants discharging to the surface water pathway. Further monitoring in subsequent years did not reveal any contaminant concentrations above laboratory detection limits. It is unlikely that these seeps currently pose a threat to the surface water pathway. The presence of asphalt material on the ground and areas of stained soil throughout the Site may represent a threat to the surface water pathway via overland drainage routes. Large-capacity storage tanks on-site are known to contain "bottoms" of asphalt-related by-products, and structural integrity of the tanks is unknown. Additional sampling of the stained soil and asphalt material throughout the Site may be necessary to determine if an ongoing release of hazardous constituents to the surface water pathway is occurring. Sampling of the tank contents may be necessary to determine if they contain hazardous materials that have the potential to release to the environment. It is also recommended that the structural integrity of the tanks be evaluated to determine if any are leaking and/or subject to overflow during rain events.

5. SOIL EXPOSURE AND AIR PATHWAYS

5.1 Physical Conditions

No change. The site is underlain by Bama Series soils, consisting of deep, well-drained, moderately permeable soils that have a moderate available water capacity. (Ref 3)

5.2 Soil and Air Targets

The 2000 US Census states that the average household size for Tuscaloosa County is 2.58 persons with population density of 124.5 persons per square mile. (Ref 12) The estimated total population in the 4-mile radius of the Site is 1,974 (Att 1). The population distribution is summarized in the table below:

Table 1
CERCLA Reassessment
Cracker Asphalt Site
Tuscaloosa County, Alabama
Demographic Data
4-mile Radius

Distance From Site (miles)	Population
0.00-0.25	12
0.25-0.50	32
0.50-1.0	107
1.0-2.0	419
2.0-3.0	621
3.0-4.0	783
Total Population	**1,974**

There are no schools or daycare centers within 200 feet of the Site. There are two residences 200 feet of the southern boundary of the site. B & W Heads employs four full-time workers on-site. The adjacent business, Alabama Biodiesel Corporation, is currently inactive and no workers are present. There are no fences securing the site except for a fence along the west side of the site separating Alabama Biodiesel Corporation property from the Site. Thick vegetation and/or forested areas border most of the Site. The area is accessible to the public via Cracker Asphalt Road and surrounding properties to the north and east. (Fig 1, Att 2)

5.3 Soil Exposure and Air Pathway Conclusions

There are no schools or daycare centers located in 200 feet of the Site and two residences are 200 feet from the southern boundary. There are four full-time workers on-site near areas of concern. There are no gates or fences preventing access to the Site, representing a potential threat to human health through direct contact with potentially hazardous materials. Areas of stained soil were observed at the Site as well as areas of solidified tar and/or asphalt. Large-capacity tanks containing "bottoms" and other asphalt-related by-products are located on-site. It is unknown whether these substances exhibit hazardous characteristics, although it is likely that any aromatic compounds originally present have since volatilized. Sampling of the stained soil, areas of solidified tar and/or asphalt, and the tank bottoms may be necessary to determine if these substances are hazardous and if they pose a threat to human health and the environment.

6. SUMMARY AND CONCLUSIONS

The Cracker Asphalt site is located in Moundville, Alabama, near the Black Warrior River. The Site was purchased by Mr. Conrad Wesselhoeft in 1968. Various tanks, structures, and equipment were left on-site by previous owners of the asphalt company. The current owner operates a custom metal fabrication business, using one of the former warehouses and shops. Several large-capacity storage tanks were removed and sold as scrap metal, but most of the original tanks are still present. Some tanks contain bottoms and other asphalt-related by-products. Areas of solidified tar, asphalt, and stained soil are present throughout the Site as well.

At one time, Mr. Wesselhoeft leased a large-capacity storage tank to the adjacent Southern Resins Company for storage of by-product petroleum solvents. The tank was later determined to be a source of groundwater contamination in the area. Since the early 1990s, Southern Resins Company conducted groundwater monitoring in coordination with ADEM. The most recent groundwater monitoring data show a consistent decline in contaminant concentrations in down-gradient wells. As a result, ADEM allowed Eastman Resins (subsequent owner of Southern Resins) to discontinue groundwater monitoring at the site. Other sample data collected from springs and seeps along the banks of the Carthage Branch and the Black Warrior River indicate that groundwater contamination has significantly declined in these areas as well.

There are few public drinking water wells within four miles of the Site, and these are screened in the deeper Coker formation, which is confined by a thick clay layer. Any remaining groundwater contamination is not expected to pose a threat to local public water systems. Private water wells have been documented in the area, and additional surveys of nearby residences may be needed to determine if the site poses a threat to nearby private wells. Additional investigation of shallow groundwater at the Site may be warranted if private water wells are found in close proximity to the site, and if tar and asphalt material on the ground throughout the site are shown to contain leachable hazardous constituents.

There are no public water supply intakes located along the 15-mile surface water pathway. The Site does not appear to represent a potential threat to public water supplies via surface water routes. Groundwater to surface water discharge from nearby seeps and springs does not represent a threat to the surface water pathway since recent sample data indicate contaminant concentrations below detection limits. Wetlands and other sensitive environments located along portions of the Black Warrior River could be negatively affected by conditions at the Site. Additional sampling of the stained soil and asphalt material throughout the area may be necessary to determine if an ongoing release of hazardous constituents to the surface water pathway is occurring. Sampling of the tank contents may be necessary to determine if they contain hazardous materials that have the potential to release to the environment.

There are no schools or daycare centers within 200 feet of the site and two residences are 200 feet from the southern site boundary. There are four full-time workers on-site near areas of concern. There are no gates or fences preventing access to the site, which may represent a threat to human health through direct contact with potentially hazardous materials. Areas of stained soil were observed at the Site as well as areas of solidified tar and/or asphalt. Large-capacity tanks containing "bottoms" and other asphalt-related by-products are located on-site. It is unknown whether these substances exhibit hazardous characteristics, although it is likely that any aromatic compounds present have already volatilized. Sampling of the stained soil, areas of solidified tar and/or asphalt, and the tank bottoms may be necessary to determine if these substances are hazardous and pose a threat to human health and the environment. Typically, abandoned, off-specification tar and asphalt would not be associated with hazardous wastes and toxic constituents. However, no true sampling determinations have been performed on the contents of the tanks.

Evaluation of tank contents and areas of stained soil may be needed in order to determine if a removal action is necessary. The owner of the Site has been advised to retain an environmental consultant to assist with the assessment and removal of tank bottoms and to address other areas of concern. At this time, the Site does not appear to warrant further action under CERCLA.

REFERENCES

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2. US Department of Commerce, US Department of Agriculture, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, January, 1963

3. Stamps, Jeremy H., ADEM, Land Division, Site Investigation, Cracker Asphalt, Moundville, Tuscaloosa County, Alabama, EPA ID No. AL0000472712, Ref. No. 6243, 1995

4. County Commission, Tuscaloosa County, Alabama, Online Tax Assessment Maps, January 13, 2011, <http://www.emapsplus.com/ALTuscaloosa/maps/>

5. TTL, Inc., 2005 Semi-Annual Groundwater Monitoring Report, Eastman Resins Site, Moundville, Tuscaloosa County, Alabama, November 22, 2005

6. Guin, Richard J., Eastman Chemical Company, Correspondence: RE: Termination of Groundwater Monitoring & Final Report, July 10, 2006

7. Bryant, James L., ADEM, Land Division, Correspondence: RE: Termination of Groundwater Monitoring Activities, February 29, 2008

8. Alabama Department of Environmental Management. 2008. *Public Water System Details for: Montgomery (AL0000651)*, Drinking Water Watch, SDWIS Version 1.2.

9. Alabama Department of Environmental Management. 2008. Water Use Classification for Interstate and Intrastate Waters, Revised May 27, 2008. Water Quality Program, Water Division, p. 301-344.

10. US Fish and Wildlife Service, Daphne Field Office, "Alabama's Federally Listed Species," Alabama Ecological Field Station, March 2, 2010, <http://www.fws.gov/daphne/es/specieslst.html#Tuscaloosa>

11. USGS, Surface Water Annual Statistics for Alabama, Gauging Station No. 02462500 – Black Warrior River at Bankhead Lock & Dam Near Bessemer, AL, January 13, 2011

12. US Department of Commerce, US Census Bureau, Profiles of General Demographic Characteristics: 2000, Geographic area: Tuscaloosa County, Alabama, Profiles of General Demo. Characteristics, May 2001, <http://www.census.gov/prod/cen2000/dp1/2kh01.pdf>

ATTACHMENTS

1. Ford, Joseph L., ADEM, Permits and Services Division, Information Systems Branch, Comprehensive Exposure Pathway Target Map, Map assembled and graphic additions made utilizing ArcView© GIS 3.2, Background image U.S.G.S. 7.5 Minute Series (Scale 1:24,000) Topographic Quadrangle Maps of Alabama: Duncanville, Alabama; Englewood, Alabama; Fosters, Alabama; Knoxville, Alabama; Moundville East, Alabama; Moundville West, Alabama; Payne Lake, Alabama; and Ralph, Alabama.

2. Hendrix, Dylan C., ADEM, Land Division, Trip Report and Photo Documentation Log, Site Reassessment for Cracker Asphalt Site, EPA ID No. AL0000472712, March 2, 2011

****** CONFIDENTIAL ******
******PRE-DECISIONAL DOCUMENT ******
****** SUMMARY SCORESHEET ******
****** FOR COMPUTING PROJECTED HRS SCORE ******

****** Do Not Cite or Quote ******

Site Name: Cracker Asphalt

Region: Region 4

Scenario Name: Scenario 1

City, County, State: Moundville, Tuscaloosa County, Alabama

Evaluator: Dylan Hendrix

EPA ID#: AL0000472712

Date: 02/28/2011

Lat/Long: 33:00:42.86,87:37:22.18

Congressional District:

This Scoresheet is for: Other

Scenario Name: Scenario 1

Description:

	S pathway	S^2 pathway
Ground Water Migration Pathway Score (S_{gw})	0.64	0.41
Surface Water Migration Pathway Score (S_{sw})	0.01	0.0
Soil Exposure Pathway Score (S_s)	0.33	0.11
Air Migration Score (S_a)	0.0	0.0
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$		0.52
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		0.13
$/ (S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		0.36

Pathways not assigned a score (explain):

TABLE 3-1 --GROUND WATER MIGRATION PATHWAY SCORESHEET

Factor categories and factors	Maximum Value	Value Assigned	
Aquifer Evaluated: Gordo Formation & Terrace Deposits			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	550.0	
2. Potential to Release:			
2a. Containment	10	10.0	
2b. Net Precipitation	10	6.0	
2c. Depth to Aquifer	5	3.0	
2d. Travel Time	35	25.0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	340.0	
3. Likelihood of Release (higher of lines 1 and 2e)	550		550.0
Waste Characteristics:			
4. Toxicity/Mobility	(a)	1000.0	
5. Hazardous Waste Quantity	(a)	10.0	
6. Waste Characteristics	100		10.0
Targets:			
7. Nearest Well	(b)	0.0	
8. Population:			
8a. Level I Concentrations	(b)	0.0	
8b. Level II Concentrations	(b)	0.0	
8c. Potential Contamination	(b)	0.0	
8d. Population (lines 8a + 8b + 8c)	(b)	0.0	
9. Resources	5	5.0	
10. Wellhead Protection Area	20	0.0	
11. Targets (lines 7 + 8d + 9 + 10)	(b)		5.0
Ground Water Migration Score for an Aquifer:			
12. Aquifer Score [(lines 3 x 6 x 11)/82,5000][c]	100		0.34
Ground Water Migration Pathway Score:			
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100		0.64

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

Table 3-1 --Ground Water Migration Pathway Scoresheet			
Factor categories and factors	Maximum Value	Value Assigned	
Aquifer Evaluated: Coker Formation			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	0.0	
2. Potential to Release:			
2a. Containment	10	10.0	
2b. Net Precipitation	10	6.0	
2c. Depth to Aquifer	5	3.0	
2d. Travel Time	35	5.0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	140.0	
3. Likelihood of Release (higher of lines 1 and 2e)	550		140.0
Waste Characteristics:			
4. Toxicity/Mobility	(a)	1000.0	
5. Hazardous Waste Quantity	(a)	10.0	
6. Waste Characteristics	100		10.0
Targets:			
7. Nearest Well	(b)	2.0	
8. Population:			
8a. Level I Concentrations	(b)	0.0	
8b. Level II Concentrations	(b)	0.0	
8c. Potential Contamination	(b)	30.6	
8d. Population (lines 8a + 8b + 8c)	(b)	30.6	
9. Resources	5	0.0	
10. Wellhead Protection Area	20	5.0	
11. Targets (lines 7 + 8d + 9 + 10)	(b)		37.6
Ground Water Migration Score for an Aquifer:			
12. Aquifer Score [(lines 3 x 6 x 11)/82,5000][c]	100		0.64
Ground Water Migration Pathway Score:			
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100		0.64

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 4-1 --SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Watershed Evaluated: Warrior River			
Drinking Water Threat			
Likelihood of Release:			
1. Observed Release	550	0.0	
2. Potential to Release by Overland Flow:			
2a. Containment	10	10.0	
2b. Runoff	10	1.0	
2c. Distance to Surface Water	5	16.0	
2d. Potential to Release by Overland Flow [lines 2a(2b + 2c)]	35	170.0	
3.Potential to Release by Flood:			
3a. Containment (Flood)	10	10.0	
3b. Flood Frequency	50	0.0	
3c. Potential to Release by Flood (lines 3a x 3b)	500	0.0	
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	170.0	
5. Likelihood of Release (higher of lines 1 and 4)	550		170.0
Waste Characteristics:			
6. Toxicity/Persistence	(a)	400.0	
7. Hazardous Waste Quantity	(a)	10.0	
8. Waste Characteristics	100		6.0
Targets:			
9. Nearest Intake	50	0.0	
10. Population:			
10a. Level I Concentrations	(b)	0.0	
10b. Level II Concentrations	(b)	0.0	
10c. Potential Contamination	(b)	0.0	
10d. Population (lines 10a + 10b + 10c)	(b)	0.0	
11. Resources	5	0.0	
12. Targets (lines 9 + 10d + 11)	(b)		0.0
Drinking Water Threat Score:			
13. Drinking Water Threat Score [(lines 5x8x12)/82,500, subject to a max of 100]	100		0.0
Human Food Chain Threat			
Likelihood of Release:			
14. Likelihood of Release (same value as line 5)	550		170.0
Waste Characteristics:			
15. Toxicity/Persistence/Bioaccumulation	(a)	2.0E7	
16. Hazardous Waste Quantity	(a)	10.0	
17. Waste Characteristics	1000		100.0
Targets:			
18. Food Chain Individual	50	0.0	
19. Population			
19a. Level I Concentration	(b)	0.0	
19b. Level II Concentration	(b)	0.0	
19c. Potential Human Food Chain Contamination	(b)	0.0	
19d. Population (lines 19a + 19b + 19c)	(b)	0.0	
20. Targets (lines 18 + 19d)	(b)		0.0
Human Food Chain Threat Score:			
21. Human Food Chain Threat Score [(lines 14x17x20)/82500, subject to max of 100]	100		0.0
Environmental Threat			
Likelihood of Release:			
22. Likelihood of Release (same value as line 5)	550		170.0
Waste Characteristics:			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	2.0E7	
24. Hazardous Waste Quantity	(a)	10.0	
25. Waste Characteristics	1000		100.0

Targets:			
26. Sensitive Environments			
26a. Level I Concentrations	(b)	0.0	
26b. Level II Concentrations	(b)	0.0	
26c. Potential Contamination	(b)	0.03	
26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	0.03	
27. Targets (value from line 26d)	(b)		0.03
Environmental Threat Score:			
28. Environmental Threat Score [(lines 22x25x27)/82,500 subject to a max of 60]	60		0.01
Surface Water Overland/Flood Migration Component Score for a Watershed			
29. Watershed Score[c] (lines 13+21+28, subject to a max of 100}	100		0.01
Surface Water Overland/Flood Migration Component Score			
30. Component Score (S_{sw})[c] (highest score from line 29 for all watersheds evaluated)	100		0.01

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 4-25 --GROUND WATER TO SURFACE WATER MIGRATION COMPONENT SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Watershed Evaluated: Warrior River			
Drinking Water Threat			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	0.0	
2. Potential to Release:			
2a. Containment	10	0.0	
2b. Net Precipitation	10	0.0	
2c. Depth to Aquifer	5	0.0	
2d. Travel Time	35	0.0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	0.0	
3. Likelihood of Release (higher of lines 1 and 2e)	550		0.0
Waste Characteristics:			
4. Toxicity/Mobility	(a)	0.0	
5. Hazardous Waste Quantity	(a)	10.0	
6. Waste Characteristics	100		0.0
Targets:			
7. Nearest Well	(b)	0.0	
8. Population:			
8a. Level I Concentrations	(b)	0.0	
8b. Level II Concentrations	(b)	0.0	
8c. Potential Contamination	(b)	0.0	
8d. Population (lines 8a + 8b + 8c)	(b)	0.0	
9. Resources	5	0.0	
10. Targets (lines 7 + 8d + 9)	(b)		0.0
Drinking Water Threat Score:			
11. *Drinking Water Threat Score ([lines 3 x 6 x 10]/82,500, subject to max of 100)*	100		0.0
Human Food Chain Threat			
Likelihood of Release:			
12. Likelihood of Release (same value as line 3)	550	0.0	
Waste Characteristics:			
13. Toxicity/Mobility/Persistence/Bioaccumulation	(a)	0.0	
14. Hazardous Waste Quantity	(a)	10.0	
15. Waste Characteristics	1000		0.0
Targets:			
16. Food Chain Individual	50	0.0	
17. Population			
17a. Level I Concentration	(b)	0.0	
17b. Level II Concentration	(b)	0.0	
17c. Potential Human Food Chain Contamination	(b)	0.0	
17d. Population (lines 17a + 17b + 17c)	(b)	0.0	
18. Targets (lines 16 + 17d)	(b)		0.0
Human Food Chain Threat Score:			
19. Human Food Chain Threat Score [(lines 12x15x18)/82,500,suject to max of 100]	100		0.0
Environmental Threat			
Likelihood of Release:			
20. Likelihood of Release (same value as line 3)	550		0.0
Waste Characteristics:			
21. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	0.0	
22. Hazardous Waste Quantity	(a)	10.0	
23. Waste Characteristics	1000		0.0
Targets:			
24. Sensitive Environments			
24a. Level I Concentrations	(b)	0.0	
24b. Level II Concentrations	(b)	0.0	

24c. Potential Contamination	(b)	0.0	
24d. Sensitive Environments (lines 24a + 24b + 24c)	(b)	0.0	
25. Targets (value from line 24d)	(b)		0.0
Environmental Threat Score:			
26. Environmental Threat Score [(lines 20x23x25)/82,500 subject to a max of 60]	60		0.0
Ground Water to Surface Water Migration Component Score for a Watershed			
27. Watershed Score[c] (lines 11 + 19 + 28, subject to a max of 100)	100		0.0
28. Component Score (S_{gs})[c] (highest score from line 27 for all watersheds evaluated, subject to a max of 100)	100		0.0

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 5-1 --SOIL EXPOSURE PATHWAY SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Likelihood of Exposure:			
1. Likelihood of Exposure	550		550.0
Waste Characteristics:			
2. Toxicity	(a)	1000.0	
3. Hazardous Waste Quantity	(a)	10.0	
4. Waste Characteristics	100		10.0
Targets:			
5. Resident Individual	50		
6. Resident Population:			
6a. Level I Concentrations	(b)	0	
6b. Level II Concentrations	(b)		
6c. Population (lines 6a + 6b)	(b)		
7. Workers	15	5.0	
8. Resources	5		
9. Terrestrial Sensitive Environments	(c)		
10. Targets (lines 5 + 6c + 7 + 8 + 9)	(b)		5.0
Resident Population Threat Score			
11. Resident Population Threat Score (lines 1 x 4 x 10)	(b)		27500.0
Nearby Population Threat			
Likelihood of Exposure:			
12. Attractiveness/Accessibility	100	10.0	
13. Area of Contamination	100	5.0	
14. Likelihood of Exposure	500		5.0
Waste Characteristics:			
15. Toxicity	(a)	1000.0	
16. Hazardous Waste Quantity	(a)	10.0	
17. Waste Characteristics	100		10.0
Targets:			
18. Nearby Individual	1	1.0	
19. Population Within 1 Mile	(b)	0.21000000000 000002	
20. Targets (lines 18 + 19)	(b)		1.21
Nearby Population Threat Score			
21. Nearby Population Threat (lines 14 x 17 x 20)	(b)		60.5
Soil Exposure Pathway Score:			
22. Pathway Score[d] (S_s), [lines (11+21)/82,500, subject to max of 100]	100		0.33

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] No specific maximum value applies to factor. However, pathway score based solely on terrestrial sensitive environments is limited to a maximum of 60
[d] Do not round to nearest integer

TABLE 6-1 --AIR MIGRATION PATHWAY SCORESHEET		
Factor categories and factors	Maximum Value	Value Assigned
Likelihood of Release:		
1. Observed Release	550	
2. Potential to Release:		
2a. Gas Potential to Release	500	
2b. Particulate Potential to Release	500	
2c. Potential to Release (higher of lines 2a and 2b)	500	
3. Likelihood of Release (higher of lines 1 and 2c)	550	
Waste Characteristics:		
4. Toxicity/Mobility	(a)	
5. Hazardous Waste Quantity	(a)	
6. Waste Characteristics	100	
Targets:		
7. Nearest Individual	50	
8. Population:		
8a. Level I Concentrations	(b)	
8b. Level II Concentrations	(b)	
8c. Potential Contamination	(c)	
8d. Population (lines 8a + 8b + 8c)	(b)	
9. Resources	5	
10. Sensitive Environments:		
10a. Actual Contamination	(c)	
10b. Potential Contamination	(c)	
10c. Sensitive Environments (lines 10a + 10b)	(c)	
11. Targets (lines 7 + 8d + 9 + 10c)	(b)	
Air Migration Pathway Score:		
12. Pathway Score (S_a) [(lines 3 x 6 x 11)/82,500][d]	100	

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c]No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited to a maximum of 60.
[d] Do not round to nearest integer

SCRATCH PAD NOTES:

PATHWAY/SOURCES: AIR

PATHWAY/SOURCES: AREA OF CONTAMINATION (AOC) INFORMATION

PATHWAY/SOURCES: GROUND WATER

Scoresheet Line#: 2a.
Notes: No containment present. Source is a groundwater plume originating on or near the site and extending west throughout the adjacent Eastman Resins site.
Documentation: SI

Scoresheet Line#: 2c.
Notes: Depth to Aquifer was assigned a value of "3", because bore data from the 1986 Hydrogeologic Study performed by CH2M HILL indicated that the depth to water for all monitoring wells (with the exception of MW-6) was greater than 25' below ground surface.
Documentation: SI, 1986 CH2MHILL Hydro Rpt.

Scoresheet Line#: 2d.
Notes: A Travel Time Factor Value of "25" was assigned based on bore data from the 1986 Hydrogeologic Study performed by CH2MHILL. The Gordo/Terrace aquifer is composed of sand/clay mixtures and medium to coarse sand/gravel. Estimated conductivity of these materials is between 10e-3 and 10e-4. The thickness of the Gordo/Terrace aquifer is approximately 90' below ground surface.
Documentation: SI, 1986 CH2MHILL Hydro Rpt.

Scoresheet Line#: 7
Notes: There are no wells within a 4-mile radius of the site that draw water from the Gordo/Terrace aquifers. The Moundville Water Works wells are screened in the Coker Formation, which is discontinuous with the overlying formations due to a thick (~50) confining clay layer.
Documentation: SI

Scoresheet Line#: 8c
Potential Population Contamination value was "306" based on the following information:

Within the 0-.250 mile radius, there were 12 individuals served, resulting in a Distance-weighted Population Value of "17"

Within the .25-.50 mile radius, there were 32 individuals served, resulting in a Distance-weighted Population Value of "33"

Within the .50-1 mile radius, there were 107 individuals served, resulting in a Distance-weighted Population Value of "52"

Within the 1-2 mile radius, there were 419 individuals served, resulting in a Distance-weighted Population Value of "94"

Within the 2-3 mile radius, there were 621 individuals served, resulting in a Distance-weighted Population Value of "68"

Within the 3-4 mile radius, there were 783 individuals served, resulting in a Distance-weighted Population Value of "42"

The sum of all the distance-weighted values resulted in a final value of "306"

Scoresheet Line#: 9
Notes: There are no drinking water wells within the 4-mile distance limit, and the Gordo/Terrace aquifers are suitable for drinking water purposes. Therefore, a Resources Value of "5" was assigned.
Documentation: SI

Scoresheet Line#: 2c. (Coker)
Notes: Depth to Aquifer was assigned a value of "3", because bore data from the 1986 Hydrogeologic Study performed by CH2MHILL indicated that the uppermost sand beds of the Coker Formation occurred at 165' below ground surface. The Coker Formation is overlain by a thick (~50') confining layer of clay.
Documentation: SI, 1986 CH2MHILL Hydro Rpt.

Scoresheet Line#: 2d. (Coker)
Notes: A Travel Time Factor Value of "5" was assigned for the Coker Formation due to the low permeability of the upper clay layer (~ 10e-7) and the thicknes of the clay layer, which appears to range from 50' to 75' thick.
Documentation: SI, 1986 CH2MHILL Hydro Rpt.

Scoresheet Line#: 7. (Coker)

Notes: A Nearest Well Factor Value of "2" was assigned because the nearest drinking water well (WL001) was within the 3-4 mile distance radius.
Documentation: SI

Scoresheet Line#: 10. (Coker)
Notes: Within the 4-mile target distance limit, there are Wellhead Protection Areas; these are not within the area of observed contamination. Therefore a value of "5" was assigned for this line.
Documentation: ADEM SWAA Viewer

PATHWAY/SOURCES: GROUND WATER TO SURFACE WATER – DRINKING WATER

PATHWAY/SOURCES: GROUND WATER TO SURFACE WATER – ENVIRONMENTAL

PATHWAY/SOURCES: GROUND WATER TO SURFACE WATER – HUMAN FOOD CHAIN

PATHWAY/SOURCES: SOIL EXPOSURE – RESIDENTIOAL POPULATION THREAT

Scoresheet Line#: 7.
Notes: There are four full-time workers on-site, resulting in a value of "5" from Table 5-4.
Documentation: RA

PATHWAY/SOURCES: SOIL EXPOSURE – NEARBY POPULATION THREAT

Scoresheet Line#: 12.
Notes: Site is unfenced and accessible with no public recreation use. There is a Native American ceremonial mound located on-site, and nearby universities send classes to study the mound. The Attractiveness/Accessibility Value of "10" was a conservative estimate, but the value may be higher due to the occaisional use of the area for student surveys.
Documentation: RA

Scoresheet Line#: 13.
Notes: This value is an estimate. The actual area of observed contamination may be smaller or larger, depending on material contents.
Documentation: RA

Scoresheet Line#: 18.
Notes: There are residences within 1/4 mile of the site, resulting in a Nearby Individual Value of "1".
Documentation: RA

PATHWAY/SOURCES: SITE SCENARIO INFORMATION

PATHWAY/SOURCES: SOURCES

PATHWAY/SOURCES: SURFACE WATER OVERLAND - DRINKING WATER

Scoresheet Line#: 10
Notes: There are no drinking water intakes located along the 15-mile surface water pathway. Therefore, there are no potential drinking water targets for this pathway.
Documentation: RA, SI

Scoresheet Line#: 11
Notes: No information could be found that would indicate any uses of surface water for irrigation, recreation (other than Fish & Wildlife), watering of commercial livestock, or as an ingredient in commercial food preparation.
Documentation: RA, SI

PATHWAY/SOURCES: SURFACE WATER OVERLAND – ENVIRONMENTAL

Scoresheet Line#: 26c.
Notes: The dilution weight for the Black Warrior River is ".001", based on flow data, the river has a mean annual flow rate of 6,443 cfs. There are 9.39 miles of wetland frontage along the surface water pathway, resulting in a Wetland Rating Value of "250" from Table 4-24. Because Federal threatened and endangered species are known to inhabit this area of the Black Warrior River, a Sensitive Environment Value of "75" was assigned from Table 4-23. The dilution weight was multiplied by the sum of the Sensitive Environment Value and the Wetland Rating Value [.001(250 + 75)], resulting in a Potential Contamination Factor Value of ".325".
Documentation: RA

PATHWAY/SOURCES: SURFACE WATER OVERLAND - HUMAN FOOD CHAIN

Scoresheet Line#: 18
Notes: A value of "0" was assigned for the HFC Individual line due to the fact that there has been no observed release to the surface water pathway and that the Black Warrior River has a mean annual flow rate of 6,443 cfs, which places it in the category of "Large Stream to River". The dilution factor for this water body is ".001", and multiplied by "20" results in a value of ".02"; the nearest integer being "0".
Documentation: RA

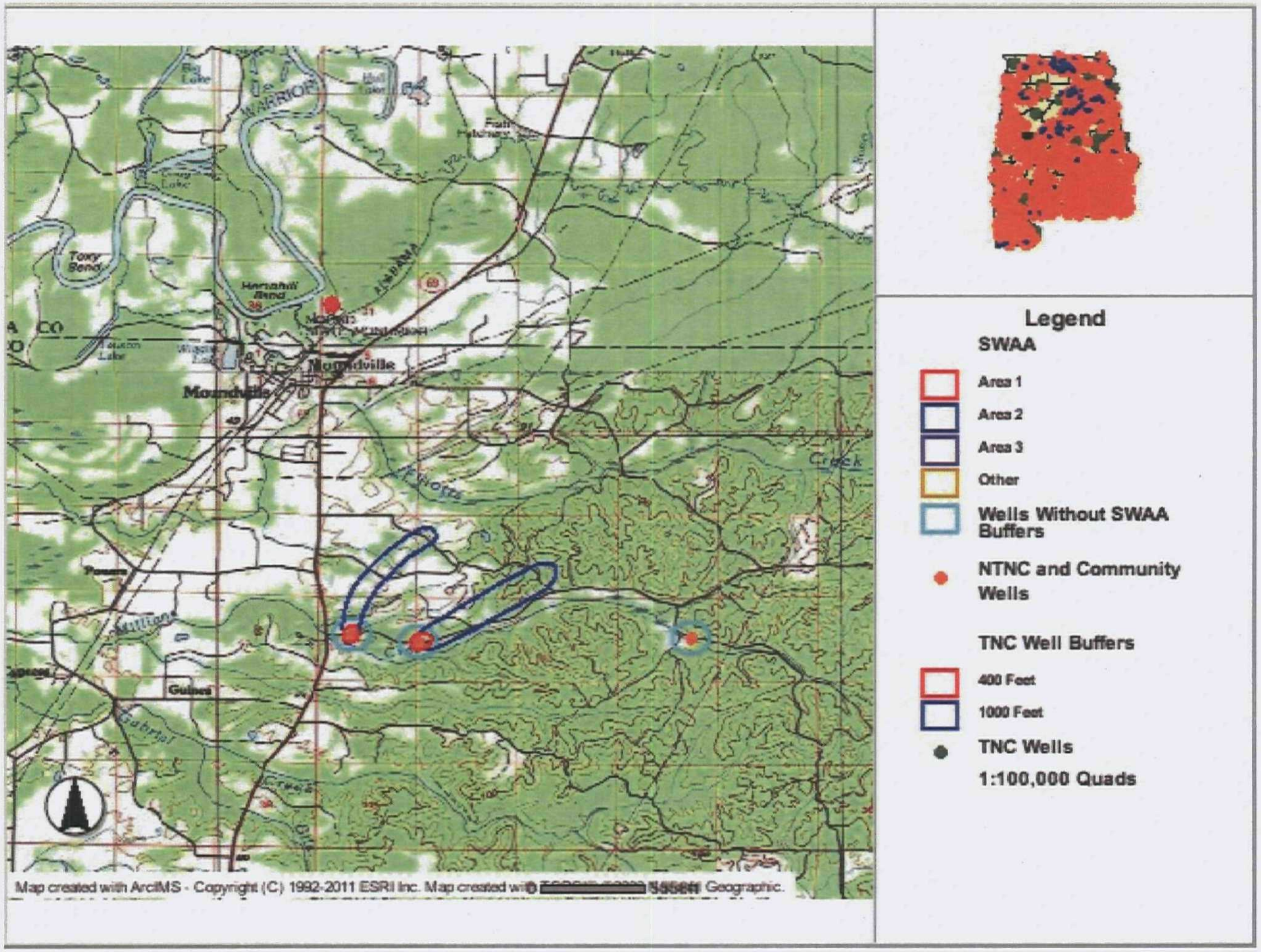
Scoresheet Line#: 19c.
Notes: Because there was no direct or surrogate data to provide a basis for HFC production on the Black Warrior River, a conservative estimate of "Greater than 0 to 100 pounds per year" was used, and a HFC Population Value of ".03" was assigned.
Documentation: RA, SI

FIGURE

1


Cracker Asphalt
http://www.teleatlas.com
© 2009 USDA-FSA-APFO NAIP
512 ft

FIGURE 2



Moundville
WARRIOR
Legend
SWAA
Area 1
Area 2
Area 3
Other
Wells Without SWAA Buffers
NTNC and Community Wells
TNC Well Buffers
400 Feet
1000 Feet
TNC Wells
1:100,000 Quads
Map created with ArcIMS - Copyright (C) 1992-2011 ESRI Inc. Map created wi [redacted] Geographic.

FIGURE
3

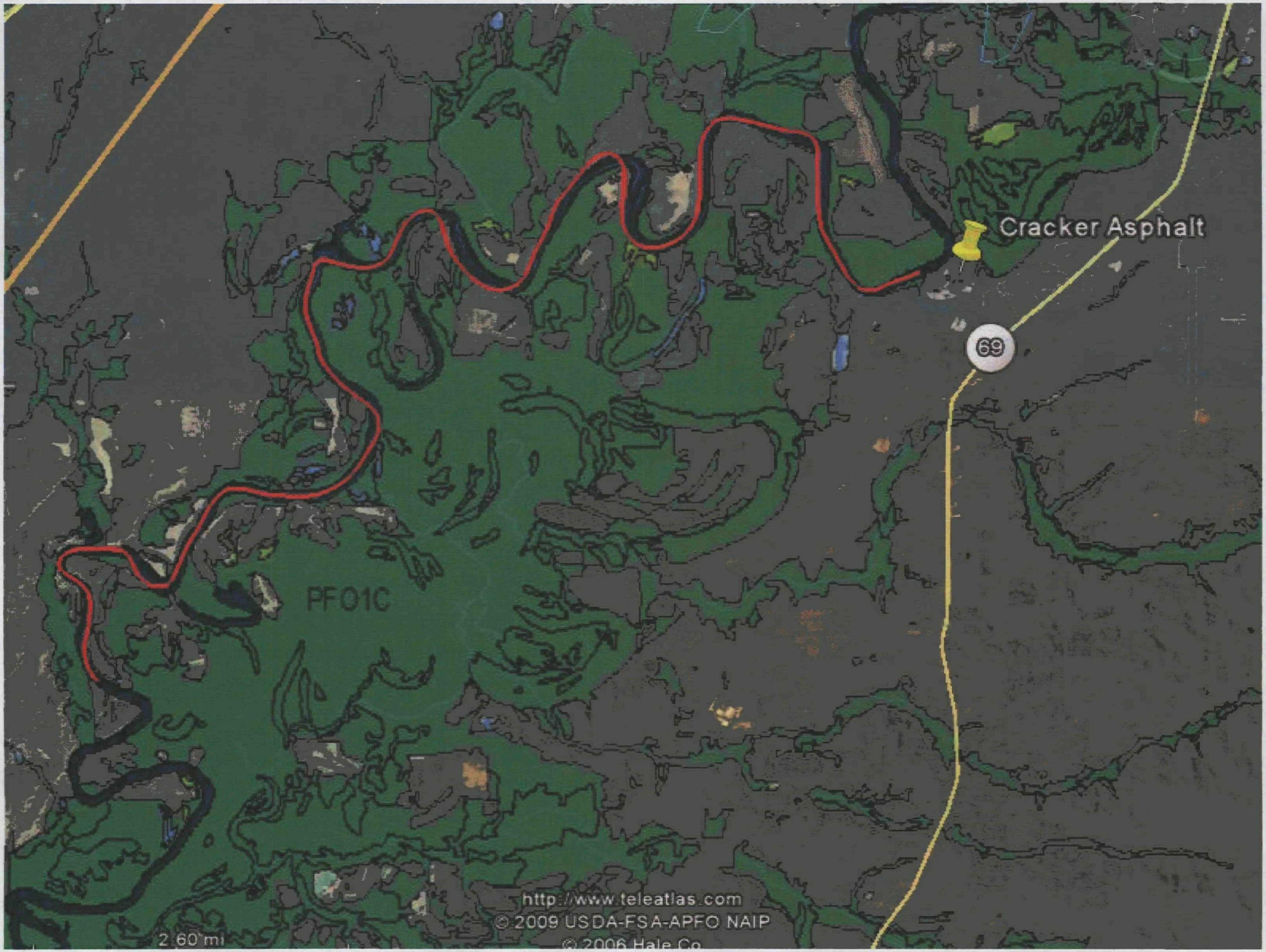
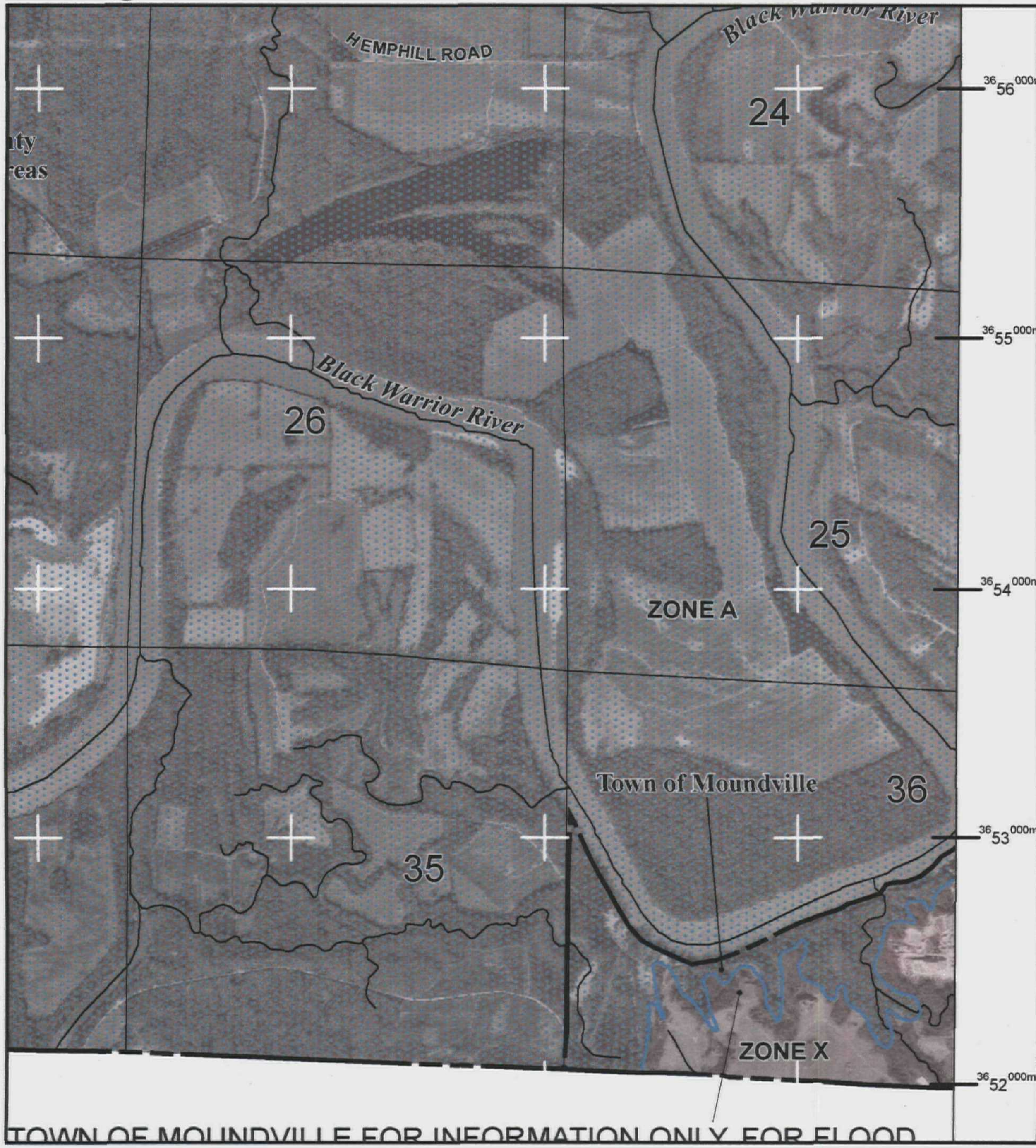

Cracker Asphalt
69
PFO1C
http://www.teleatlas.com
© 2009 USDA-FSA-APFO NAIP
© 2006 Hale Co
2.60 mi

FIGURE
4



MAP SCALE 1" = 2000'

00 0 2000 4000 FEET

NFIP

PANEL 0675F

FIRM
FLOOD INSURANCE RATE MAP

TUSCALOOSA COUNTY, ALABAMA
AND INCORPORATED AREAS

PANEL 675 OF 750
(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MOUNDVILLE, TOWN OF	010096	0675	F
TUSCALOOSA COUNTY	010201	0675	F

NATIONAL FLOOD INSURANCE PROGRAM

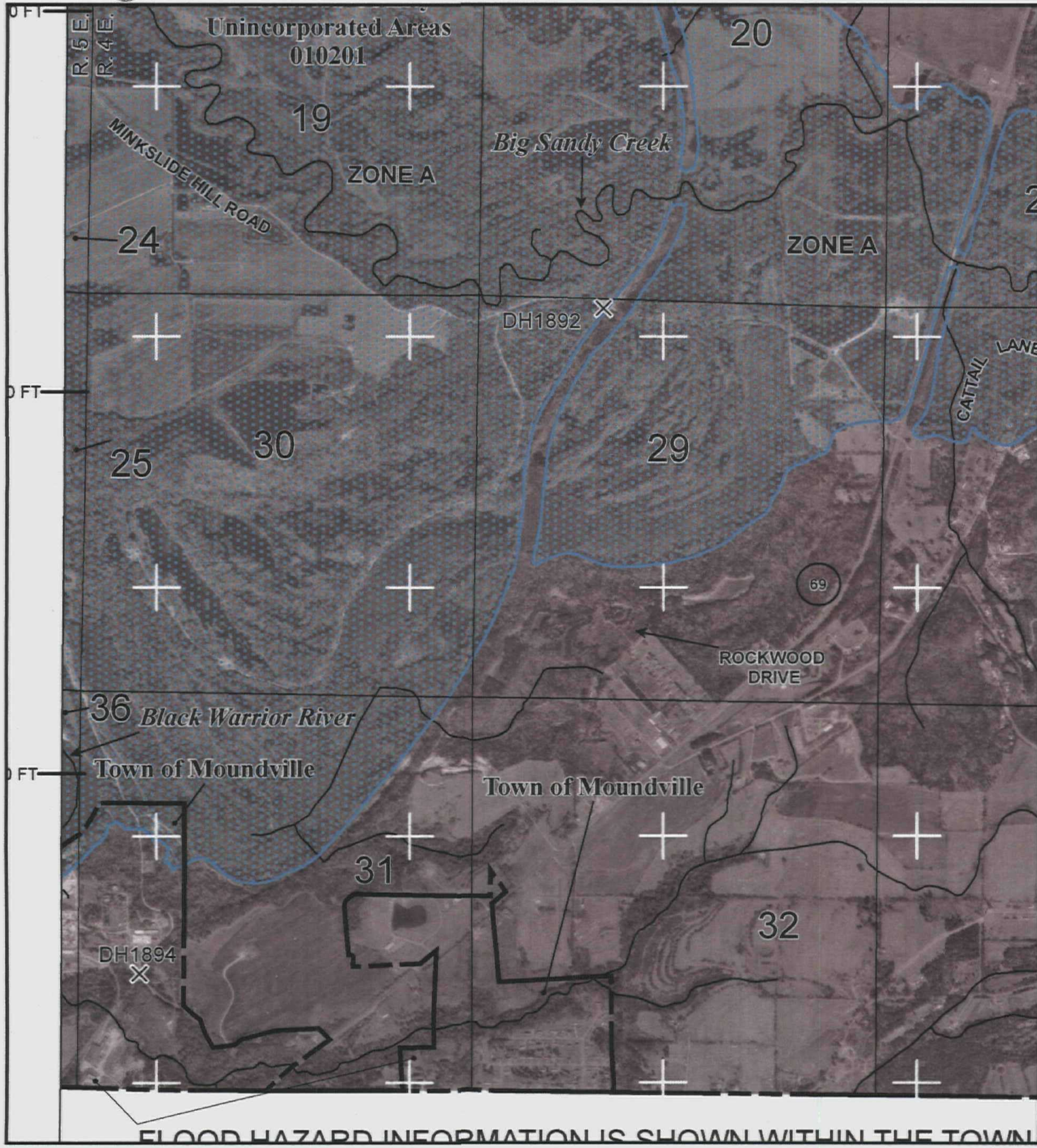
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

EFFECTIVE DATE SEPTEMBER 28, 2007

MAP NUMBER 01125C0675F

State of Alabama
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 2000'

0 2000 4000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0700F

FIRM
FLOOD INSURANCE RATE MAP

TUSCALOOSA COUNTY, ALABAMA
AND INCORPORATED AREAS

PANEL 700 OF 750
(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MOUNDVILLE, TOWN OF	010096	0700	F
TUSCALOOSA COUNTY	010201	0700	F
TUSCALOOSA, CITY OF	010203	0700	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

EFFECTIVE DATE SEPTEMBER 28, 2007

MAP NUMBER 01125C0700F

State of Alabama
Federal Emergency Management Agency

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REFERENCE
1

TUSCALOOSA FAA AIRPORT, ALABAMA

Period of Record General Climate Summary - Temperature

From Year=1948 To Year=2010												
Station:(018380) TUSCALOOSA FAA AIRPORT												
Averages Daily Extremes												
	Monthly Averages			Daily Extremes				Monthly Extremes				Ma Ter
	Max.	Min.	Mean	High	Date	Low	Date	Highest Mean	Year	Lowest Mean	Year	>= 90 F
	F	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	F	-	F	-	# Days
January	55.3	34.5	44.9	82	10/1949	-1	19/1977	60.6	50	33.1	77	0.0
February	59.9	37.0	48.5	86	13/1962	5	02/1951	56.1	57	38.8	78	0.0
March	68.0	43.7	55.8	90	23/1995	12	14/1993	62.9	107	45.6	60	0.0
April	76.5	51.2	63.9	94	21/1987	29	01/1987	69.4	99	58.7	83	0.3
May	83.6	60.2	71.9	98	31/1951	36	04/1976	76.5	100	64.4	76	5.8
June	89.8	67.6	78.7	105	28/1952	45	03/1956	84.1	52	73.8	61	17.1
July	92.3	71.3	81.8	107	24/1952	54	01/1950	85.5	110	77.0	67	23.1
August	92.0	70.5	81.2	107	10/2007	53	22/1956	87.8	107	74.7	67	22.3
September	86.8	64.5	75.6	104	01/1951	37	30/1967	80.5	102	69.6	67	11.5
October	77.4	51.8	64.6	98	04/1954	23	30/1952	70.9	104	56.7	52	1.2
November	66.3	41.8	54.1	87	01/2000	10	25/1950	61.1	85	46.8	76	0.0
December	57.7	36.1	46.9	82	03/1978	2	23/1989	55.0	71	36.9	63	0.0
Annual	75.5	52.5	64.0	107	19520724	-1	19770119	66.8	107	61.0	76	81.2
Winter	57.6	35.9	46.7	86	19620213	-1	19770119	54.4	50	38.3	78	0.0
Spring	76.0	51.7	63.9	98	19510531	12	19930314	66.8	55	59.6	60	6.1
Summer	91.3	69.8	80.6	107	19520724	45	19560603	84.9	110	76.8	67	62.5
Fall	76.8	52.7	64.8	104	19510901	10	19501125	69.5	98	59.5	76	12.6

Table updated on Mar 24,
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons
Winter = Dec., Jan., and Feb. Spring = Mar., Apr., and May
Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

TUSCALOOSA FAA AIRPORT, ALABAMA

Period of Record General Climate Summary - Precipitation

From Year=1948 To Year=2010														
Station:(018380) TUSCALOOSA FAA AIRPORT														
Averages Daily Extremes														
	Precipitation											Total Snowfall		
	Mean	High	Year	Low	Year	1 Day Max.		>= 0.01 in.	>= 0.10 in.	>= 0.50 in.	>= 1.00 in.	Mean	High	Yea
	in.	in.	-	in.	-	in.	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days	in.	in.	-
January	5.32	10.18	79	1.22	61	4.26	26/1996	10	8	4	2	0.2	4.0	7
February	5.09	14.79	61	0.35	96	5.44	21/1961	9	7	4	2	0.2	7.0	6
March	5.77	19.99	76	1.12	86	6.08	13/1975	10	8	4	2	0.1	3.8	9
April	4.92	14.41	79	0.30	87	6.44	12/1979	8	6	3	2	0.0	0.3	8
May	4.27	11.13	76	0.32	65	4.00	15/2008	8	6	3	1	0.0	0.0	4
June	3.95	11.98	89	0.61	52	3.41	18/1963	8	6	3	1	0.0	0.0	4
July	5.00	12.27	97	0.72	70	4.57	21/1997	10	8	3	2	0.0	0.0	4
August	3.80	8.84	70	0.57	53	2.87	10/1967	8	6	3	1	0.0	0.0	4
September	3.48	10.91	109	0.00	55	6.28	03/2001	7	5	2	1	0.0	0.0	4
October	3.26	9.11	95	0.00	63	5.73	25/1977	6	4	2	1	0.0	0.0	4
November	4.41	14.25	48	0.67	49	3.67	11/1995	8	6	3	1	0.0	0.0	4
December	4.81	11.05	83	0.69	80	3.64	20/1951	10	7	4	1	0.0	2.7	6
Annual	54.09	78.35	83	32.42	107	6.44	19790412	103	77	38	17	0.5	7.0	6
Winter	15.23	26.51	83	6.56	81	5.44	19610221	29	22	11	5	0.4	7.0	6
Spring	14.96	33.83	76	4.18	107	6.44	19790412	26	20	10	5	0.1	3.8	9
Summer	12.76	27.00	105	4.52	54	4.57	19970721	27	19	9	4	0.0	0.0	4
Fall	11.15	22.85	109	4.86	78	6.28	20010903	21	16	8	4	0.0	0.0	4

Table updated on Mar 24,
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons
Winter = Dec., Jan., and Feb. Spring = Mar., Apr., and May
Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

REFERENCE

2

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RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division

for

Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

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PREFACE

This publication is intended as a convenient summary of empirical relationships, working guides, and maps, useful in practical problems requiring rainfall frequency data. It is an outgrowth of several previous Weather Bureau publications on this subject prepared under the direction of the author and contains an expansion and generalization of the ideas and results in earlier papers. This work has been supported and financed by the Soil Conservation Service, Department of Agriculture, to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention program (P.L. 566, 83d Congress and as amended).

The paper is divided into two parts. The first part presents the rainfall analyses. Included are measures of the quality of the various relationships, comparisons with previous works of a similar nature, numerical examples, discussions of the limitations of the results, transformation from point to areal frequency, and seasonal variation. The second part presents 49 rainfall frequency maps based on a comprehensive and integrated collection of up-to-date statistics, several related maps, and seasonal variation diagrams. The rainfall frequency (isopluvial) maps are for selected durations from 30 minutes to 24 hours and return periods from 1 to 100 years.

This study was prepared in the Cooperative Studies Section (Joseph L. H. Paulhus, Chief) of Hydrologic Services Division (William E. Hiatt, Chief). Coordination with the Soil Conservation Service, Department of Agriculture, was maintained through Harold O. Ogrosky, Chief, Hydrology Branch, Engineering Division. Assistance in the study was received from several people. In particular, the author wishes to acknowledge the help of William E. Miller who programmed the frequency and duration functions and supervised the processing of all the data; Normalee S. Foat who supervised the collection of the basic data; Howard Thompson who prepared the maps for analysis; Walter T. Wilson, a former colleague, who was associated with the development of a large portion of the material presented here; Max A. Kohler, A. L. Shands, and Leonard L. Weiss, of the Weather Bureau, and V. Mockus and R. G. Andrews, of the Soil Conservation Service, who reviewed the manuscript and made many helpful suggestions. Caroll W. Gardner performed the drafting.

CONTENTS

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

DAVID M. HERSHFIELD

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INTRODUCTION

Historical review

Until about 1953, economic and engineering design requiring rainfall frequency data was based largely on Yarnell's paper [1] which contains a series of generalized maps for several combinations of durations and return periods. Yarnell's maps are based on data from about 200 first-order Weather Bureau stations which maintained complete recording-gage records. In 1940, about 5 years after Yarnell's paper was published, a hydrologic network of recording gages was installed to supplement both the Weather Bureau recording gages and the relatively larger number of nonrecording gages. The additional recording gages have subsequently increased the amount of short-duration data by a factor of 20.

Weather Bureau *Technical Paper No. 24*, Parts I and II [2], prepared for the Corps of Engineers in connection with their military construction program, contained the first studies covering an extended area which exploited the hydrologic network data. The results of this work showed the importance of the additional data in defining the short-duration rainfall frequency regime in the mountainous regions of the West. In many instances, the differences between *Technical Paper No. 24* and Yarnell reach a factor of three, with the former generally being larger. Relationships developed and knowledge gained from these studies in the United States were then used to prepare similar reports for the coastal regions of North Africa [3] and several Arctic regions [4] where recording-gage data were lacking.

Cooperation between the Weather Bureau and the Soil Conservation Service began in 1955 for the purpose of defining the depth-area-duration-frequency regime in the United States. *Technical Paper No. 25* [5], which was partly a by-product of previous work performed for the Corps of Engineers, was the first paper published under the sponsorship of the Soil Conservation Service. This paper contains a series of rainfall intensity-duration-frequency curves for 200 first-order Weather Bureau stations. This was followed by *Technical Paper No. 28* [6], which is an expansion of *Technical Paper No. 24* to longer return periods and durations. Next to be published were the five parts of the *Technical Paper No. 29* series [7], which cover the region east of 90° W. Included in this series are seasonal variation on a frequency basis and area-depth curves so that the point frequency values can be transformed to areal frequency. Except for the region between 90° W. and 105° W., the contiguous United States has been covered by generalized rainfall frequency studies prepared by the Weather Bureau since 1953.

General approach

The approach followed in the present study is basically that utilized in [6] and [7]. In these references, simplified duration and return-period relationships and several key maps were used to determine additional combinations of return periods and durations. In this study, four key maps provided the basic data for these two relationships which were programmed to permit digital computer computations for a 3500-point grid on each of 45 additional maps.

PART I: ANALYSES

Basic data

Types of data.—The data used in this study are divided into three categories. First, there are the recording-gage data from the long-record first-order Weather Bureau stations. There are 200 such stations with records long enough to provide adequate results within the range of return periods of this paper. These data are for the n-minute period containing the maximum rainfall. Second, there are the recording-gage data of the hydrologic network which are published for clock-hour intervals. These data were processed for the 24 consecutive clock-hour intervals containing the maximum rainfall—not calendar-day. Finally, there is the very large amount of nonrecording-gage data with observations made once daily. Use was made of these data to help define both the 24-hour rainfall regime and also the shorter duration regimes through applications of empirical relationships.

Station data.—The sources of data are indicated in table 1. The data from the 200 long-record Weather Bureau stations were used to develop most of the relationships which will be described later. Long records from more than 1600 stations were analyzed to define the relationships for the rarer frequencies (return periods), and statistics from short portions of the record from about 5000 stations were used as an aid in defining the regional pattern for the 2-year return period. Several thousand additional stations were considered but not plotted where the station density was adjudged to be adequate.

Period and length of record.—The nonrecording short-record data were compiled for the period 1938–1957 and long-record data from the earliest year available through 1957. The recording-gage data cover the period 1940–1958. Data from the long-record Weather Bureau stations were processed through 1958. No record of less than five years was used to estimate the 2-year values.

TABLE 1.—*Sources of point rainfall data*

Duration	No. of stations	Average length of record (yr.)	Reference No.
30-min. to 24-hr.	200	48	8, 9, 10
Hourly	2081	14	11, 12
Daily (recording)	1850	16	11, 12
Daily (nonrecording)	3409	15	13
Daily (nonrecording)	1428	47	13

Clock-hour vs. 60-minute and observational-day vs. 1440-minute rainfall.—In order to exploit the clock-hour and observational-day data, it was necessary to determine their relationship to the 60-minute and 1440-minute periods containing the maximum rainfall. It was found that 1.13 times a rainfall value for a particular return period based on a series of annual maximum clock-hour rainfalls was equivalent to the amount for the same return period obtained from a series of 60-minute rainfalls. By coincidence, it was found that the same factor can be used to transform observational-day amounts to corresponding 1440-minute return-period amounts. The equation, n-year 1440-minute rainfall (or 60-minute) equals 1.13 times n-year observational-day (or clock-hour) rainfall, is not built on a causal relationship. This is an average index relationship because the distributions of 60-minute and 1440-minute rainfall are very irregular or unpredictable during their respective time intervals. In addition, the annual maxima from the two series for the same year from corresponding durations do not necessarily come from the same storm. Graphical comparisons of these data are presented in figure 1, which shows very good agreement.

24 consecutive clock-hour rainfall vs. 1440-minute rainfall.—The recording-gage data were collected from published sources for the 24 consecutive clock-hours containing the maximum rainfall. Because of the arbitrary beginning and ending on the hour, a series of these data provides statistics which are slightly smaller in magnitude than those from the 1440-minute series. The average bias was found to be approximately one percent. All such data in this paper have been adjusted by this factor.

Station exposure.—In refined analyses of mean annual and mean seasonal rainfall data it is necessary to evaluate station exposures by methods such as double-mass curve analysis [14]. Such methods do not appear to apply to extreme values. Except for some subjective selections (particularly for long records) of stations that have had consistent exposures, no attempt has been made to adjust rainfall values to a standard exposure. The effects of varying exposure are implicitly included in the areal sampling error and are probably averaged out in the process of smoothing the isopluvial lines.

Rain or snow.—The term rainfall has been used in reference to all durations even though some snow as well as rain is included in some of the smaller 24-hour amounts for the high-elevation stations. Comparison of arrays of all ranking snow events with those known to have only rain has shown trivial differences in the frequency relations for several high-elevation stations tested. The heavier (rarer frequency) 24-hour events and all short-duration events consist entirely of rain.

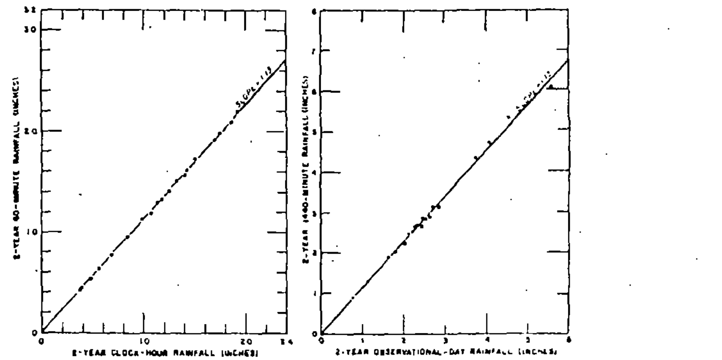

FIGURE 1.—Relation between 2-year 60-minute rainfall and 2-year clock-hour rainfall; relation between 2-year 1440-minute rainfall and 2-year observational-day rainfall.

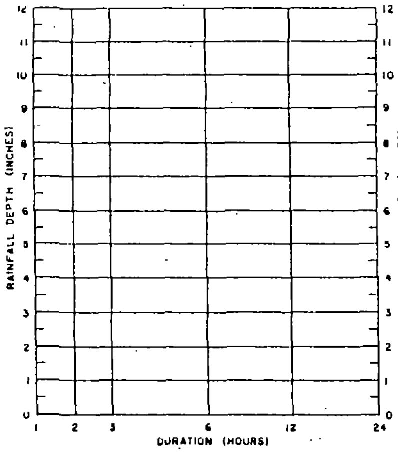

Figure 2.—Rainfall depth-duration diagram.

Duration analysis

Duration interpolation diagram.—A generalized duration relationship was developed with which the rainfall depth for a selected return period can be computed for any duration between 1 and 24 hours, when the 1- and 24-hour values for that particular return period are given (see fig. 2). This generalization was obtained empirically from data for the 200 Weather Bureau first-order stations. To use this diagram, a straightedge is laid across the values given for 1 and 24 hours and the values for other durations are read at the proper intersections. The quality of this relationship for the 2- and 6-hour durations is illustrated in figures 3 and 4 for stations with a wide range in rainfall magnitude.

Relationship between 30-minute and 60-minute rainfall.—If a 30-minute ordinate is positioned to the left of the 60-minute ordinate on the duration interpolation diagram of figure 2, acceptable estimates can be made of the 30-minute rainfall. This relationship was used in several previous studies. However, tests showed that better results can be obtained by simply multiplying the 60-minute rainfall by the average 30- to 60-minute ratio. The empirical relationship used for estimating the 30-minute rainfall is 0.79 times the 60-minute rainfall. The quality of this relationship is illustrated in figure 5.

Frequency analysis

Two types of series.—This discussion requires consideration of two methods of selecting and analyzing intense rainfall data. One method, using the partial-duration series, includes all the high values. The other uses the annual series which consists only of the highest value for each year. The highest value of record, of course, is the top value of each series, but at lower frequency levels (shorter return periods) the two series diverge. The partial-duration series, having the highest values regardless of the year in which they occur, recognizes that the second highest of some year occasionally exceeds the highest of some other year. The purposes to be served by the atlas require that the results be expressed in terms of partial-duration frequencies. In order to avoid laborious processing of partial-duration data, the annual series were collected, analyzed, and the resulting statistics transformed to partial-duration statistics.

Conversion factors for two series.—Table 2, based on a sample of a number of widely scattered Weather Bureau first-order stations, gives the empirical factors for converting the partial-duration series to the annual series.

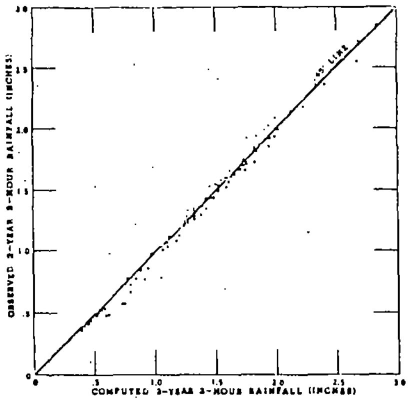

Figure 3.—Relation between observed 2-year 2-hour rainfall and 2-year 2-hour rainfall computed from duration diagram.

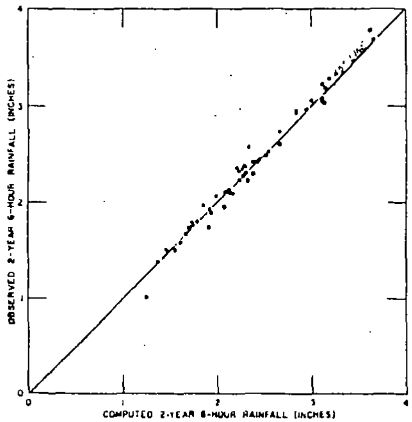

Figure 4.—Relation between observed 2-year 6-hour rainfall and 2-year 6-hour rainfall computed from duration diagram.

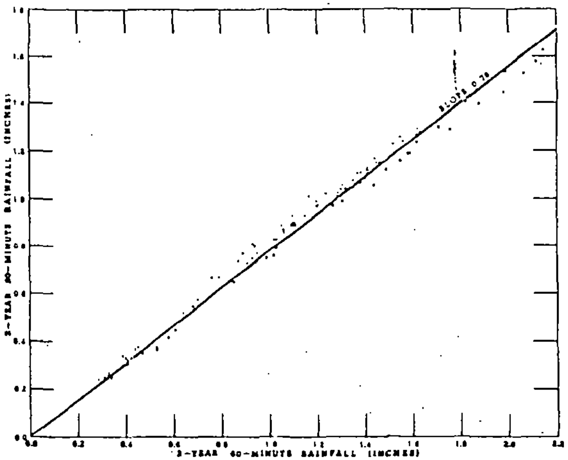

Figure 5.—Relation between 2-year 30-minute rainfall and 2-year 60-minute rainfall.

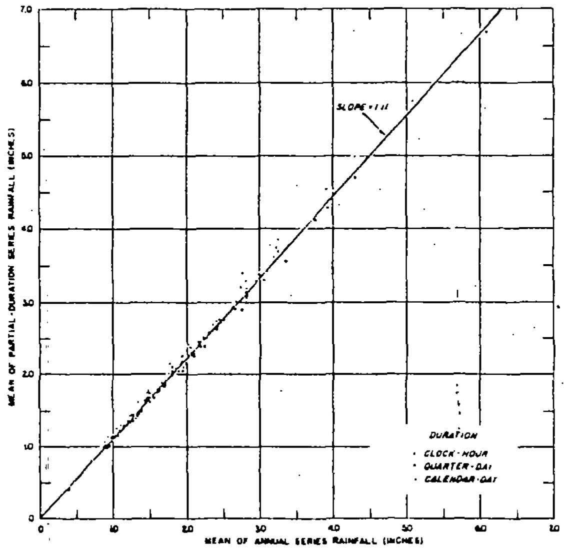

Figure 6.—Relation between partial-duration and annual series.

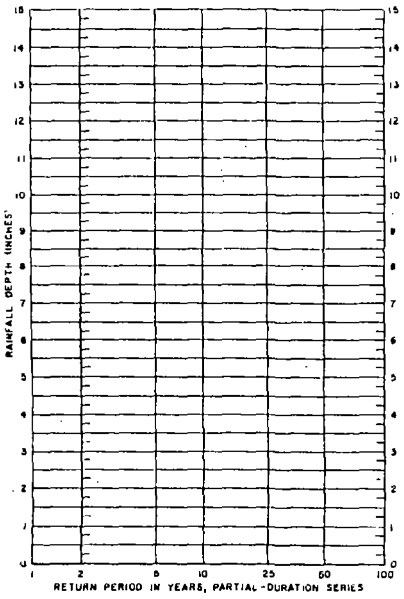

FIGURE 7.—Rainfall depth versus return period.

EXAMPLE. If the 2-, 5-, and 10-year partial-duration series values estimated from the maps at a particular point are 3.00, 3.75, and 4.21 inches, respectively, what are the annual series values for corresponding return periods? Multiplying by the appropriate conversion factors of table 2 gives 2.64, 3.60, and 4.17 inches.

The quality of the relationship between the mean of the partial-duration series and the mean of the annual series data for the 1-, 6-, and 24-hour durations is illustrated in figure 6. The means for both series are equivalent to the 2.3-year return period. Tests with samples of record length from 10 to 60 years indicate that the factors of table 2 are independent of record length.

TABLE 2.—*Empirical factors for converting partial-duration series to annual series*

Return period	Conversion factor
2-year	0.88
5-year	0.96
10-year	0.99

Frequency considerations.—Extreme values of rainfall depth form a frequency distribution which may be defined in terms of its moments. Investigations of hundreds of rainfall distributions with lengths of record ordinarily encountered in practice (less than 50 years) indicate that these records are too short to provide reliable statistics beyond the first and second moments. The distribution must therefore be regarded as a function of the first two moments. The 2-year value is a measure of the first moment—the central tendency of the distribution. The relationship of the 2-year to the 100-year value is a measure of the second moment—the dispersion of the distribution. These two parameters, 2-year and 100-year rainfall, are used in conjunction with the return-period diagram of figure 7 for estimating values for other return periods.

Construction of return-period diagram.—The return-period diagram of figure 7 is based on data from the long-record Weather Bureau stations. The spacing of the vertical lines on the diagram is partly empirical and partly theoretical. From 1 to 10 years it is entirely empirical, based on freehand curves drawn through plottings of partial-duration series data. For the 20-year and longer return periods reliance was placed on the Gumbel procedure for fitting annual series data to the Fisher-Tippett type I distribution [15]. The transition was smoothed subjectively between 10- and 20-year return periods. If rainfall values for return periods between 2 and 100 years are taken from the return-period diagram of figure 7, converted to annual series values by applying the factors of table 2, and plotted on either Gumbel or log-normal paper, the points will very nearly approximate a straight line.

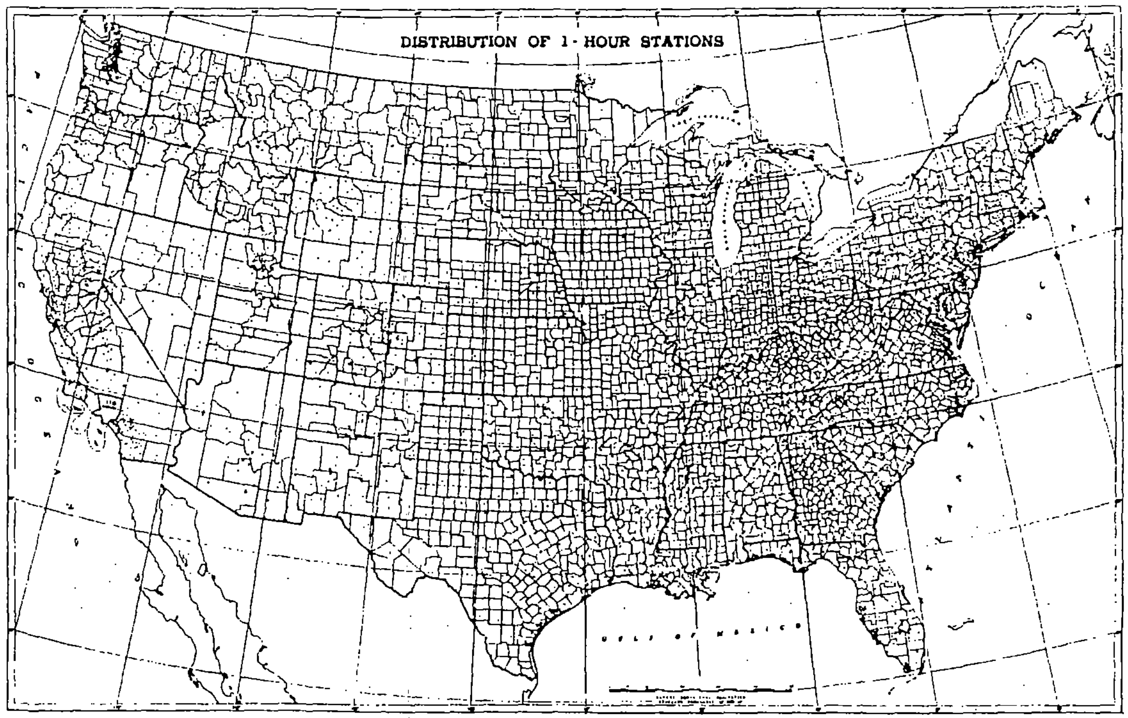

FIGURE 8.—Distribution of 1-hour stations.

Use of diagram.—The two intercepts needed for the frequency relation in the diagram of figure 7 are the 2-year values obtained from the 2-year maps and the 100-year values from the 100-year maps. Thus, given the rainfall values for both 2- and 100-year return periods, values for other return periods are functionally related and may be determined from the frequency diagram which is entered with the 2- and 100-year values.

General applicability of return-period relationship.—Tests have shown that within the range of the data and the purpose of this paper, the return-period relationship is also independent of duration. In other words, for 30 minutes, or 24 hours, or any other duration within the scope of this report, the 2-year and 100-year values define the values for other return periods in a consistent manner. Studies have disclosed no regional pattern that would improve the return-period diagram which appears to have application over the entire United States.

Secular trend.—The use of short-record data introduces the question of possible secular trend and biased sample. Routine tests with subsamples of equal size from different periods of record for the same station showed no appreciable trend, indicating that the direct use of the relatively recent short-record data is legitimate.

Storms combined into one distribution.—The question of whether a distribution of extreme rainfall is a function of storm type (tropical or nontropical storm) has been investigated and the results presented in a recent paper [16]. It was found that no well-defined dichotomy exists between the hydrologic characteristics of hurricane or tropical storm rainfall and those of rainfall from other types of storms. The conventional procedure of analyzing the annual maxima without regard to storm type is to be preferred because it avoids nonsystematic sampling. It also eliminates having to attach a storm-type label to the rainfall, which in some cases of intermediate storm type (as when a tropical storm becomes extratropical) is arbitrary.

Predictive value of theoretical distribution.—Estimation of return periods requires an assumption concerning the parametric form of the distribution function. Since less than 10 percent of the more than 6000 stations used in this study have records for 60 years or longer, this raises the question of the predictive value of the results—particularly, for the longer return periods. As indicated previously,

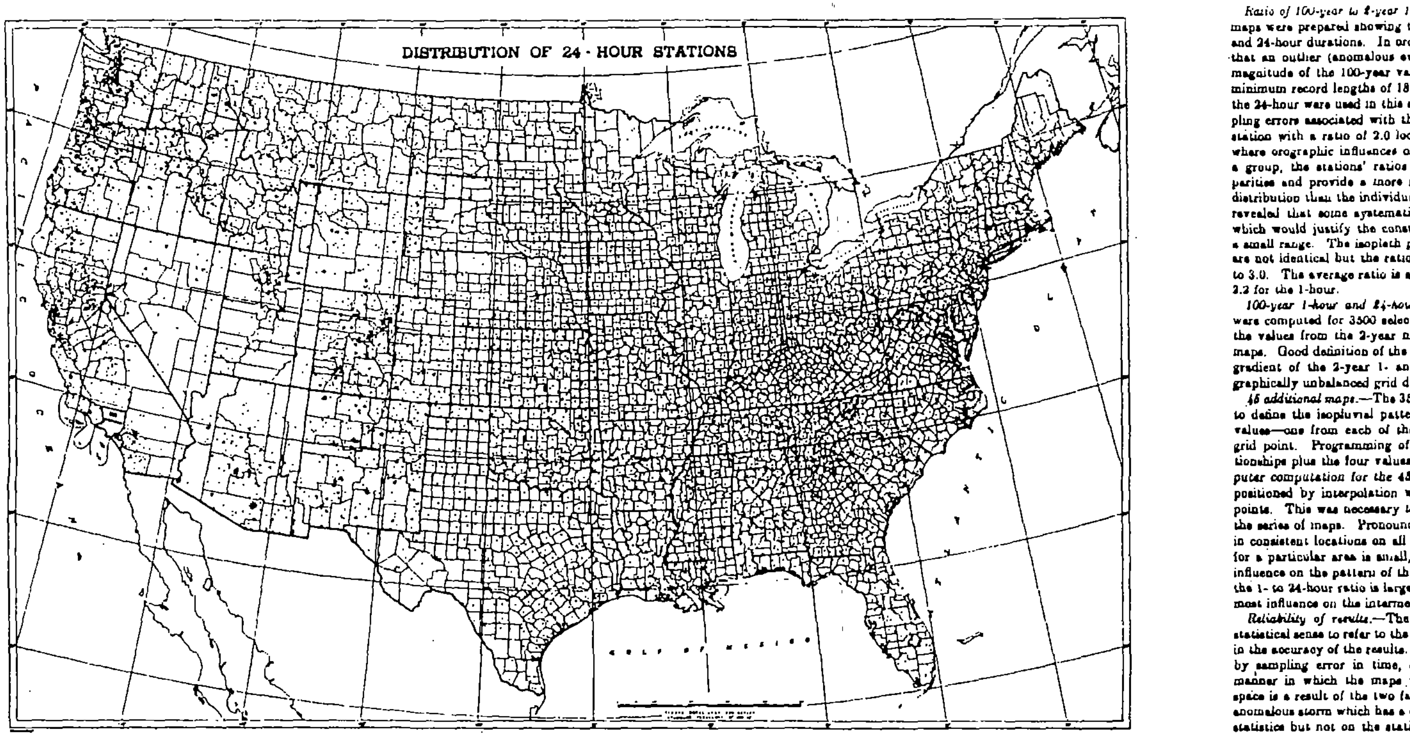

FIGURE 9.—Distribution of 24-hour stations.

reliance was placed on the Gumbel procedure for fitting data to the Fisher-Tippett type I distribution to determine the longer return periods. A recent study [17] of 60-minute data which was designed to appraise the predictive value of the Gumbel procedure provided definite evidence for its acceptability.

Isopluvial maps

Methodology.—The factors considered in the construction of the isopluvial maps were availability of data, reliability of the return period estimates, and the range of duration and return periods required for this paper. Because of the large amount of data for the 1- and 24-hour durations and the relatively small standard error associated with the estimates of the 2-year values, the 2-year 1- and 24-hour maps were constructed first. Except for the 30-minute duration, the 1- and 24-hour durations envelop the durations required for this study. The 100-year 1- and 24-hour maps were then prepared because this is the upper limit of return period. The four key maps: 2-year 1-hour, 2-year 24-hour, 100-year 1-hour, and 100-year 24-hour, provided the data to be used jointly with the duration and frequency relationships of the previous sections for obtaining values for the other 45 maps. This procedure permits variation in two directions—one for duration and the other for return period. The 49 isopluvial maps are presented in Part II as Charts 1 to 49.

Data for 2-year 1-hour map.—The dot map of figure 8 shows the location of the stations for which data were actually plotted on the map. Additional stations were considered in the analysis but not plotted in regions where the physiography could have no conceivable influence on systematic changes in the rainfall regime. All available recording-gage data with at least 5 years of record were plotted for the mountainous region west of 104° W. In all, a total of 2281 stations were used to define the 2-year 1-hour pattern of which 60 percent are for the western third of the country.

Data for 2-year 24-hour map.—Figure 9 shows the locations of the 6000 stations which provided the 24-hour data used to define the 2-year 24-hour isopluvial pattern. Use was made of most of the stations in mountainous regions including those with only 5 years of record. As indicated previously, the data have been adjusted where necessary so that they are for the 1440-minute period containing the maximum rainfall rather than observational-day.

Smoothing of 2-year 1-hour and 2-year 24-hour isopluvial lines.—The manner of construction involves the question of how much to smooth the data, and an understanding of the problem of data smoothing is necessary to the most effective use of the maps. The problem of drawing isopluvial lines through a field of data is analogous in some important respects to drawing regression lines through the data of a scatter diagram. Just as isolines can be drawn so as to fit every point on the map, an irregular regression line can be drawn to pass through every point; but the complicated pattern in each case would be unrealistic in most instances. The two qualities, smoothness and fit, are basically inconsistent in the sense that smoothness may not be improved beyond a certain point without some sacrifice of closeness of fit, and vice versa. The 2-year 1- and 24-hour maps were deliberately drawn so that the standard error of estimate (the inherent error of interpolation) was commensurate with the sampling and other errors in the data and methods of analysis.

Ratio of 100-year to 2-year 1- and 24-hour rainfall.—Two working maps were prepared showing the 100-year to 2-year ratio for the 1- and 24-hour durations. In order to minimize the exaggerated effect that an outlier (anomalous event) from a short record has on the magnitude of the 100-year value, only the data from stations with minimum record lengths of 18 years for the 1-hour and 40 years for the 24-hour were used in this analysis. As a result of the large sampling errors associated with these ratios, it is not unusual to find a station with a ratio of 2.0 located near a 3.0 ratio even in regions where orographic influences on the rainfall regime are absent. As a group, the stations' ratios mask out the station-to-station disparities and provide a more reliable indication of the direction of distribution than the individual station data. A macro-examination revealed that some systematic geographical variation was present which would justify the construction of smoothed ratio maps with a small range. The isopleth patterns constructed for the two maps are not identical but the ratios on both maps range from about 2.0 to 3.0. The average ratio is about 2.3 for the 24-hour duration and 2.2 for the 1-hour.

100-year 1-hour and 24-hour maps.—The 100-year values which were computed for 3500 selected points (fig. 10) are the product of the values from the 2-year maps and the 100-year to 2-year ratio maps. Good definition of the complexity of pattern and steepness of gradient of the 2-year 1- and 24-hour maps determined the geographically unbalanced grid density of figure 10.

45 additional maps.—The 3500-point grid of figure 10 was also used to define the isopluvial patterns of the 45 additional maps. Four values—one from each of the four key maps—were read for each grid point. Programming of the duration and return-period relationships plus the four values for each point permitted digital computer computation for the 45 additional points. The isolines were positioned by interpolation with reference to numbers at the grid points. This was necessary to maintain the internal consistency of the series of maps. Pronounced "highs" and "lows" are positioned in consistent locations on all maps. Where the 1- to 24-hour ratio for a particular area is small, the 24-hour values have the greatest influence on the pattern of the intermediate duration maps. Where the 1- to 24-hour ratio is large, the 1-hour value appears to have the most influence on the intermediate duration pattern.

Reliability of results.—The term reliability is used here in the statistical sense to refer to the degree of confidence that can be placed in the accuracy of the results. The reliability of results is influenced by sampling error in time, sampling error in space, and by the manner in which the maps were constructed. Sampling error in space is a result of the two factors: (1) the chance occurrence of an anomalous storm which has a disproportionate effect on one station's statistics but not on the statistics of a nearby station, and (2) the geographical distribution of stations. Where stations are farther apart than in the dense networks studied for this project, stations may experience rainfalls that are nonrepresentative of their vicinity, or may completely miss rainfalls that are representative. Similarly, sampling error in time results from rainfalls not occurring according to their average regime during a brief record. A brief period of record may include some nonrepresentative large storms, or may miss some important storms that occurred before or after the period of record at a given station. In evaluating the effects of areal and time sampling errors, it is pertinent to look for and to evaluate bias and dispersion. This is discussed in the following paragraphs.

Spatial sampling error.—In developing the area-depth relations, it was necessary to examine data from several dense networks. Some of these dense networks were in regions where the physiography could have little or no effect on the rainfall regime. Examination of these data showed, for example, that the standard deviation of point rainfall for the 2-year return period for a flat area of 300 square miles is about 20 percent of the mean value. Seventy 24-hour stations in Iowa, each with more than 40 years of record, provided another indication of the effect of spatial sampling error. Iowa's rainfall regime is not influenced locally by orography or bodies of water. The 2-year 24-hour isopluvials in Iowa show a range from 3.0 to 3.3 inches. The average deviation of the 70 2-year values from the smoothed isopluvials is about 0.2 inch. Since there are no assignable causes for these dispersions, they must be regarded as a residual error in sampling the relatively small amount of extreme-value data available for each station.

The geographical distribution of the stations used in the analysis is portrayed on the dot maps of figures 8 and 9. Even this relatively dense network cannot reveal very accurately the fine structure of the isopluvial pattern in the mountainous regions of the West. A measure of the sampling error is provided by a comparison of a 2-year 1-hour generalized map for Los Angeles County (4000 square miles) based on 30 stations with one based on 110 stations. The average difference for values from randomly selected points from both maps was found to be approximately 20 percent.

Sampling error in time.—Sampling error in time is present because the data at individual stations are intended to represent a mean condition that would hold over a long period of time. Daily data from 200 geographically dispersed long-record stations were analyzed for 10- and 50-year records to determine the reliability or level of confidence that should be placed on the results from the short-record data. The diagram of figure 11 shows the scatter of the means of the extreme-value distributions for the two different lengths of record. The slight bias which is exhibited is a result of the skewness of the extreme-value distribution. Accordingly, more weight was given to the longer-record stations in the construction of the isopluvials.

Isoline interval.—The isoline intervals are 0.2, 0.5, or 1.0 inch depending on the range and magnitude of the rainfall values. A uniform interval has been used on a particular map except in the two following instances: (1) a dashed intermediate line has been placed between two widely separated lines as an aid to interpolation, and (2) a larger interval was used where necessitated by a steep gradient. "Lows" that close within the boundaries of the United States have been hatched inwardly.

Maintenance of consistency.—Numerous statistical maps were made in the course of these investigations in order to maintain the internal consistency. In situations where it has been necessary to estimate hourly data from daily observations, experience has demonstrated that the ratio of 1-hour to corresponding 24-hour values for the same return period does not vary greatly over a small region. This knowledge served as a useful guide in smoothing the isopluvials. On the windward sides of high mountains in western United States, the 1- to 24-hour ratio is as low as 10 percent. In southern Arizona and some parts of midwestern United States, it is greater than 60 percent. In general, except for Arizona, the ratio is less than 40 percent west of the Continental Divide and greater than 40 percent to the east. There is a fair relationship between this ratio and the climatic factor, mean annual number of thunderstorm days. The two parameters, 2-year daily rainfall and the mean annual number of thunderstorm days, have been used jointly to provide an estimate of short-duration rainfalls [18]. A 1- to 24-hour ratio of 40 percent is approximately the average for the United States.

Examination of physiographic parameters.—Work with mean annual and mean seasonal rainfall has resulted in the derivation of empirically defined parameters relating rainfall data to the physiography of a region. Elevation, slope, orientation, distance from moisture source, and other parameters have been useful in drawing maps of mean rainfall. These and other parameters were examined in an effort to refine the maps presented here. However, tests showed that the use of these parameters would result in no improvement in the rainfall-frequency pattern because of the sampling and other error inherent in values obtained for each station.

Evaluation.—In general, the standard error of estimate ranges from a minimum of about 10 percent, where a point value can be used directly as taken from a flat region of one of the 2-year maps to 50 percent where a 100-year value of short-duration rainfall must be estimated for an appreciable area in a more rugged region.

Internal inconsistency.—On some maps the isoline interval does not reveal the fact that the magnitude does not vary linearly by interpolation. Therefore, interpolation of several combinations of durations and return periods for the point of interest might result in such inconsistencies as a 12-hour value being larger than a 24-hour value for the same return period or that a 50-year value exceeds the 100-year value for the same duration. These errors, however, are well within the acknowledged margin of error. If the reader is interested in more than one duration or return period this potential source of inconsistency can be eliminated by constructing a series of depth-duration-frequency curves by fitting smoothed curves on logarithmic paper to the values interpolated from all 49 maps. Figure 12 illustrates a set of curves for the point at 35° N., 90° W. The interpolated values for a particular duration should very nearly approximate a straight line on the return-period diagram of figure 7.

Obsolescence.—Additional stations rather than longer records will speed obsolescence and lessen the current accuracy of the maps. The comparison with Yarnell's paper [1] is a case in point. Where data for new stations are available, particularly in the mountainous regions, the isopluvial patterns of the two papers show pronounced differences. At stations which were used for both papers, even with 25 years of additional data, the differences are negligible.

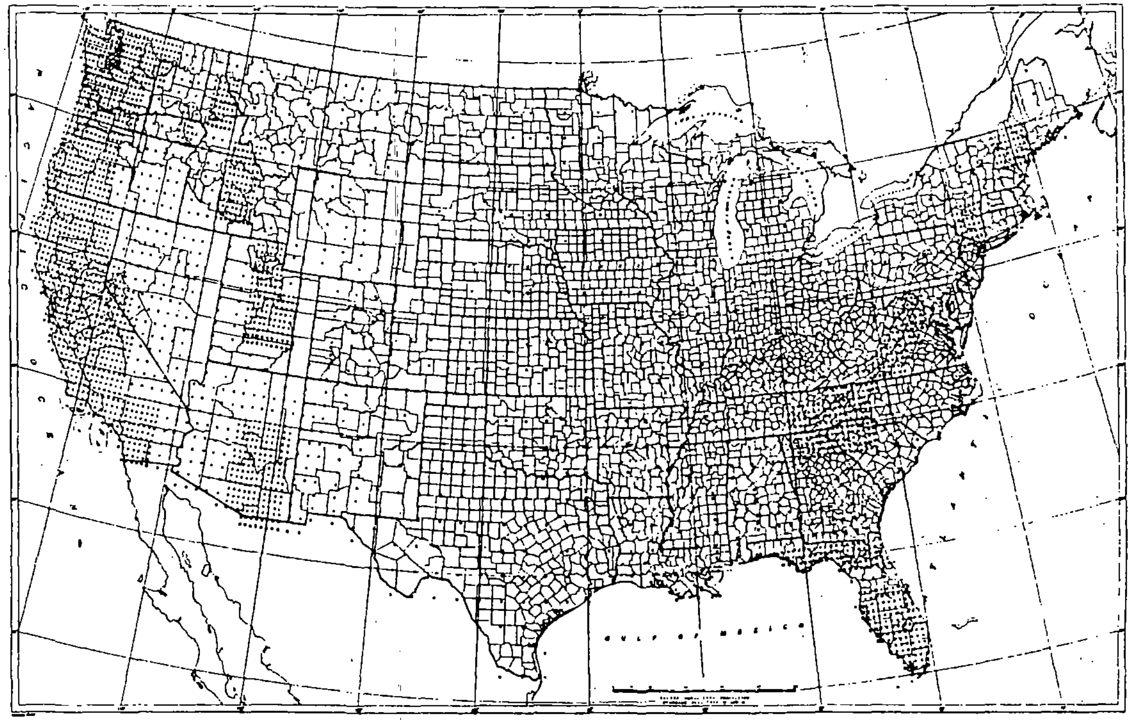

FIGURE 10.—Grid density used to construct additional maps.

Guides for estimating durations and/or return periods not presented on the maps

Intermediate durations and return periods.—In some instances, it might be required to obtain values within the range of return periods and durations presented in this paper but for which no maps have been prepared. A diagram similar to that illustrated in figure 12 can serve as a nomogram for estimating these required values.

Return periods longer than 100 years.—Values for return periods longer than 100 years can be obtained by plotting several values from 2 to 100 years from the same point on all the maps on either log-normal or extreme-value probability paper. A straight line fitted to the data and extrapolated will provide an acceptable estimate of, say, the 200-year value. It should be remembered that the values on the maps are for the partial-duration series, therefore, the 2-, 5-, and 10-year values should first be reduced by the factors of table 2.

EXAMPLE. The 200-year 1-hour value is required for the point at 35° N., 90° W. The 2-, 5-, 10-, 25-, 50-, and 100-year values are estimated from the maps to be 1.7, 2.2, 2.5, 2.6, 3.1, and 3.5 inches. After multiplying the 2-year value by 0.88, the 5-year value by 0.96, and the 10-year value by 0.99, the six values are plotted on extreme-value probability paper, a line is fitted to the data and extrapolated linearly. The 200-year value is thus estimated to be about 3.8 inches (see fig. 13).

Durations shorter than 30 minutes.—If durations shorter than 30 minutes are required, the average relationships between 30-minute rainfall on the one hand and the 5-, 10-, and 15-minute rainfall on the other can be obtained from table 3. These relationships were developed from the data of the 200 Weather Bureau first-order stations.

TABLE 3.—*Average relationship between 30-minute rainfall and shorter duration rainfall for the same return period*

Duration (min.)	5	10	15
Ratio	0.37	0.57	0.72
Average error (percent)	8	7	5

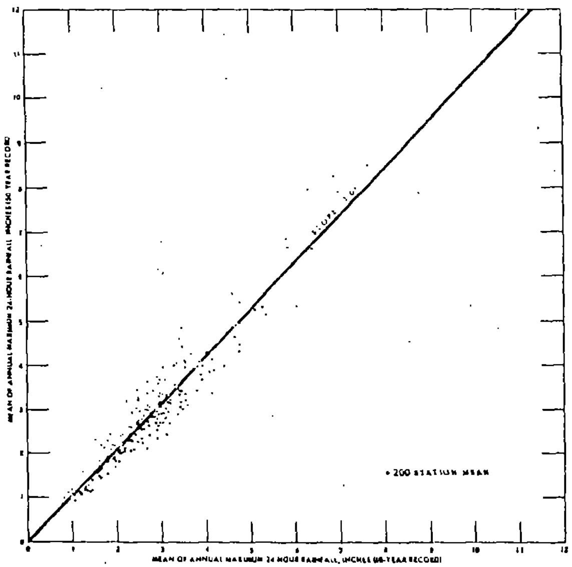

FIGURE 11.—Relation between means from 50-year and 10-year records (24-hour duration).

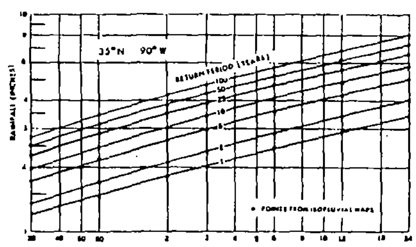

FIGURE 12.—Example of internal consistency check.

Comparisons with previous rainfall frequency studies

Yarnell.—A comparison of the results of this paper with those obtained by Yarnell's paper [1] brings out several interesting points. First, both papers show approximately the same values for the Weather Bureau first-order stations even though 25 years of additional data are now available. Second, even though thousands of additional stations were used in this study, the differences between the two papers in the eastern half of the country are quite small and rarely exceed 10 percent. However, in the mountainous regions of the West, the enlarged inventory of data now available has had a profound effect on the isopluvial pattern. In general, the results from this paper are larger in the West with the differences occasionally reaching a factor of three.

Technical Paper No. 25.—*Technical Paper No. 25* [5] contains a series of rainfall intensity-duration-frequency curves for the 200 Weather Bureau stations. The curves were developed from each station's data with no consideration given to anomalous events or to areal generalization. The average difference between the two papers is approximately 10 percent with no bias. After accounting for the fact that this atlas is for the partial-duration series and *Technical Paper No. 25* is for the annual series, the differences can be ascribed to the considerable areal generalization used in this paper.

Technical Paper No. 24, Parts I and II; Technical Paper No. 28.—The differences in refinement between *Technical Paper No. 24* [2] and *Technical Paper No. 28* [6] on the one hand and this paper on the other do not, however, seem to influence the end results to an important degree. Inspection of the values in several rugged areas, as well as in flat areas, reveals disparities which average about 20 percent. This is attributable to the much larger amount of data (both longer records and more stations) and the greater areal generalization used in this paper.

Technical Paper No. 29, Parts 1 through 5.—The salient feature of the comparison of *Technical Paper No. 29* [7] with this paper is the very small disparities between the four key maps and the slightly larger disparities between the intermediate maps. The average differences are of the order of magnitude of 10 and 20 percent, respectively. The larger difference between the intermediate maps is attributable to the smoothing of these maps in a consistent manner for this paper.

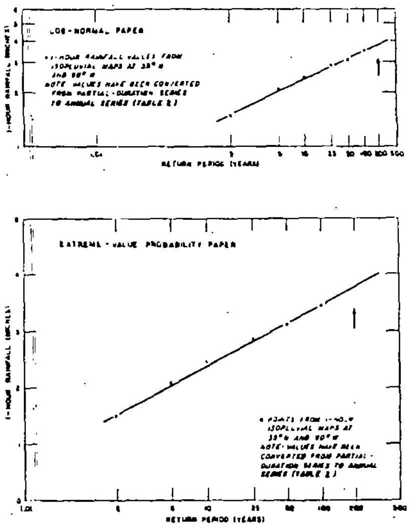

FIGURE 13.—Example of extrapolating to long return periods.

Probability considerations

General.—The analysis presented thus far has been mainly concerned with attaching a probability to a particular magnitude of rainfall at a particular location. Once this probability has been determined, consideration must also be given to the corollary question: What is the probability that the *n*-year event will occur at least once in the next *n* years?

From elementary probability theory it is known that there is a good chance that the *n*-year event will occur at least once before *n* years have elapsed. For example, if an event has the probability $1/n$ of occurring in a particular year (assume the annual series is being used), where *n* is 10 or greater, the probability, *P*, of the event occurring at least once among *n* observations (or years) is

$$P=1-(1-1/n)^n=1-e^{-1}=0.63$$

Thus, for example, the probability that the 10-year event will occur at least once in the next 10 years is 0.63, or about 2 chances out of 3.

Relationship between design return period, T years, design period, T_d, and probability of not being exceeded in T_d years.—Figure 14, prepared from theoretical computations, shows the relationship between the design return period, *T* years, design period, T_d, and probability of not being exceeded in T_d years [19].

EXAMPLE. What design return period should the engineer use to be approximately 90 percent certain that it will not be exceeded in the next 10 years? Entering the design period coordinate at 10 years until the 90 percent line is intersected, the design return period is estimated to be 100 years. In terms of rainfall magnitude, the 100-year value is approximately 50 percent larger than the 10-year value.

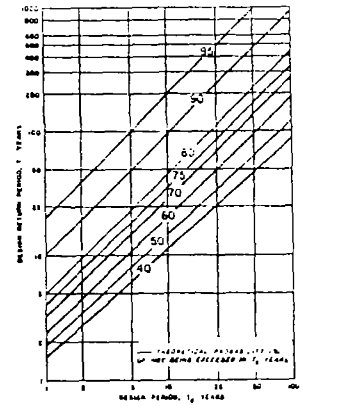

FIGURE 14.—Relationship between design return period, *T* years, design period, T_d, and probability of not being exceeded in T_d years.

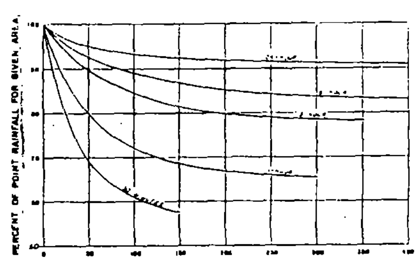

FIGURE 15.—Area-depth curves.

Probable maximum precipitation (PMP)

The 6-hour PMP and its relationship to the 100-year 6-hour rainfall.—Opposed to the probability method of rainfall estimation presented in this paper is the probable maximum precipitation (PMP) method which uses a combination of physical model and several estimated meteorological parameters. The main purpose of the PMP method is to provide complete-safety design criteria in cases where structure failure would be disastrous. The 6-hour PMP map of Chart 50 is based on the 10-square-mile values of *Hydrometeorological Report No. 33* [20] for the region east of 105° W. and on Weather Bureau *Technical Paper No. 38* [21] for the West. Chart 51 presents the ratios of the PMP values to the 100-year point rainfalls of this paper. Examination of this map shows that the ratios vary from less than 2 to about 9. These results must be considered merely indicative of the order of magnitude of extremely rare rainfalls.

Area-depth relationships

General.—For drainage areas larger than a few square miles consideration must be given not only to point rainfall, but to the average depth over the entire drainage area. The average area-depth relationship, as a percent of the point values, has been determined for 20 dense networks up to 400 square miles from various regions in the United States [7].

The area-depth curves of figure 15 must be viewed operationally. The operation is related to the purpose and application. In application the process is to select a point value from an isopluvial map. This point value is the average depth for the location concerned, for a given frequency and duration. It is a composite. The area-depth curve relates this average point value, for a given duration and frequency and within a given area, to the average depth over that area for the corresponding duration and frequency.

The data used to develop the area-depth curves of figure 15 exhibited no systematic regional pattern [7]. Duration turned out to be the major parameter. None of the dense networks had sufficient length of record to evaluate the effect of magnitude (or return period) on the area-depth relationship. For areas up to 400 square miles, it is tentatively accepted that storm magnitude (or return period) is not a parameter in the area-depth relationship. The reliability of this relationship appears to be best for the longer durations.

EXAMPLE. What is the average depth of 2-year 3-hour rainfall for a 200-square-mile drainage area in the vicinity of 37° N., 66° W? From the 2-year 3-hour map, 2.0 inches is estimated as the average depth for points in the area. However, the average 3-hour depth over the drainage area would be less than 2.0 inches for the 2-year return period. Referring to figure 15, it is seen that the 3-hour curve intersects the area scale at 200 square miles at ratio 0.8. Accordingly, the 2-year 3-hour average depth over 200 square miles is 0.8 times 2.0, or 1.6 inches.

Seasonal variation

Introduction.—To this point, the frequency analysis has followed the conventional procedures of using only the annual maxima or the *n*-maximum events for *n* years of record. Obviously, some months contribute more events to these series than others and, in fact, some months might not contribute at all to these two series. Seasonal variation serves the purpose of showing how often these rainfall events occur during a specific month. For example, a practical problem concerned with seasonal variation may be illustrated by the fact that the 100-year 1-hour rain may come from a summer thunderstorm, with considerable infiltration, whereas the 100-year flood may come from a lesser storm occurring on frozen or snow-covered ground in the late winter or early spring.

Seasonal probability diagrams.—A total of 24 seasonal variation diagrams is presented in Charts 52, 53, and 54 for the 1-, 6-, and 24-hour durations for 8 subregions of the United States east of 105° W. The 15 diagrams covering the region east of 90° W. are identical to those presented previously in *Technical Paper No. 29* [7]. The smoothed isopleths of a diagram for a particular duration are based on the average relationship from approximately 15 stations in each subregion. Some variation exists from station to station, suggesting a slight subregional pattern, but no attempt was made to define it because there is no conclusive method of determining whether this pattern is a climatic fact or an accident of sampling. The slight regional discontinuities between curves of adjacent subregions can be smoothed locally for all practical purposes. No seasonal variation relationships are presented for the mountainous region west of 105° W. because of the influence of local climatic and topographic conditions. This would call for seasonal distribution curves constructed from each station's data instead of average and more reliable curves based on groups of stations.

Application to areal rainfall.—The analysis of a limited amount of areal rainfall data in the same manner as the point data gave seasonal variations which exhibited no substantial difference from those of the point data. This lends some confidence in using these diagrams as a guide for small areas.

EXAMPLE. *Determine the probability of occurrence of a 10-year 1-hour rainfall for the months May through August for the point at 45° N., 85° W.* From Chart 52, the probabilities for each month are interpolated to be 1, 2, 4, and 2 percent, respectively. In other words, the probability of occurrence of a 10-year 1-hour rainfall in May of any particular year is 1 percent; for June, 2 percent; and so forth. (Additional examples are given in all five parts of *Technical Paper No. 29*.)

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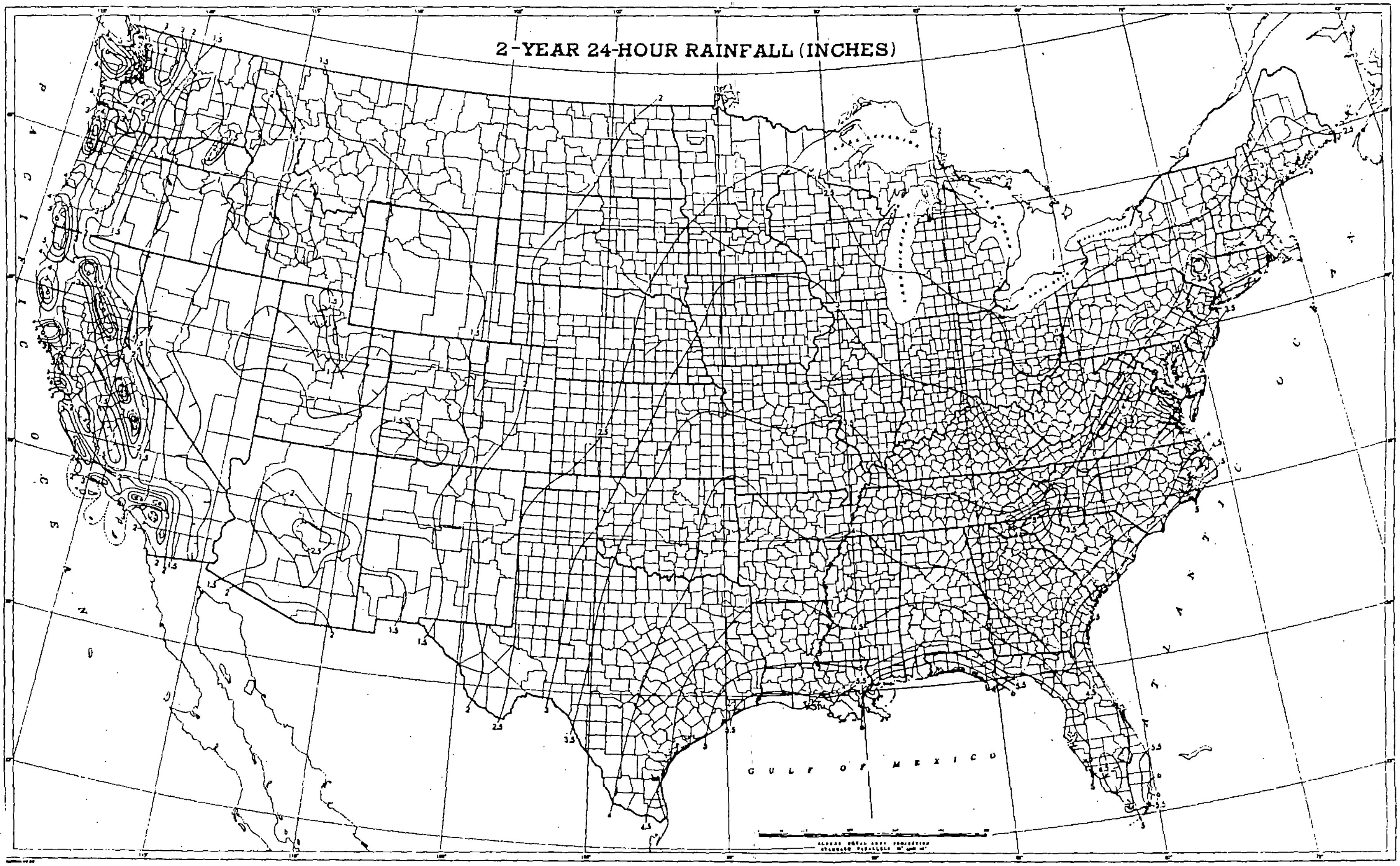
PART II

Charts 1–49: Isopluvial maps.
Charts 50–51: The 6-hour probable maximum precipitation and its relationship to the 100-year 6-hour rainfall.
Charts 52–54: Diagrams of seasonal probability of intense rainfall, for 1-, 6-, and 24-hour durations.


2-YEAR 24-HOUR RAINFALL (INCHES)
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO

REFERENCE
3

SITE INVESTIGATION
CRACKER ASPHALT
TUSCALOOSA/HALE COUNTY, ALABAMA

EPA ID NO.: 000472712

SITE REF. NO.: 6243

PREPARED BY:
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TABLE OF CONTENTS

1.0 INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization act of 1986 (SARA) and a cooperative agreement between the U. S. Environmental Protection Agency and the Alabama Department of Environmental Management (ADEM), a Site Investigation (SI) was conducted at the Cracker Asphalt site in Moundville, Tuscaloosa County, Alabama. The purpose of this investigation was to collect information concerning conditions at the site sufficient to assess the threat posed to human health and the environment and to determine the need for additional investigations under CERCLA or other authority, and, if appropriate, support site evaluation using the Hazardous Ranking System (HRS) for proposal to the National Priorities List (NPL). The investigation included reviewing previous information, sampling waste and environmental media to test Preliminary Assessment (PA) hypotheses and to evaluate and document HRS factors, Collecting additional non-sampling information, and interviewing nearby residents.

2.0 SITE DESCRIPTION

2.1 Location

The Cracker Asphalt Facility (CAF) is located in Moundville, Tuscaloosa County, Alabama. The geographic coordinates are 33° 00' 42.86" North latitude and 87° 37' 22.18" West longitude (Reference 1; Reference 2). The town of Moundville is a small incorporated community consisting of approximately 1,348 residents (Reference 3).

The Moundville area has a moist subtropical climate with precipitation well distributed throughout the year. Tuscaloosa County receives precipitation of 0.10 inch or more approximately 75 days out of each year and has an average yearly precipitation of 49.26 inches. (Reference 4, p. 76).

The mean annual temperature for Tuscaloosa County is approximately 63.4° *F*. On a monthly average, January is the coldest and July is the warmest. January has an average daily maximum temperature of 54.9° *F* and an average daily minimum temperature of 33.5° *F*. July has an average daily maximum temperature of 91.7° F and an average daily minimum of 70.2° *F*. (Reference 4, p. 76)

2.2 Site Description

The CAF site is located in the SW 1/4 of the NW 1/4 and the NW 1/4 of the SW 1/4 of Section 31, Township 24 North, Range 5 East in Tuscaloosa County, Alabama. The CAF site is bound on the north by pine forest and swamp land, and then by the Black Warrior River; on the south by rail road tracks, and then by residential property and farm land; on the east by a dirt methane well access road, and then by pine forest and swamp land; on the west by Lawter Chemical Plant, and then by the Mound State Monument. The nearest residential property is approximately 400 feet to the south of the site.

The CAF site is a 25-acre dogleg shaped parcel of land. It is presently improved with 9 buildings, 24 above ground storage tanks and a lagoon that captures much of the surface water runoff from the site. The site is accessible to the general public from all directions. The only part of the site currently being utilized are the buildings on the site.

The CAF site is approximately 100 to 175 feet above mean sea level with a 2 to 6 percent sloping topography. All the area surrounding the CAF site is at elevations lower than that of the site. Therefore, surface water runoff from the surrounding area would not flow across site under normal conditions. The Black Warrior River runs along the northwest boundary of the CAF site and is the nearest probable point of entry (PPE) into the surface water pathway for runoff exiting from the site.

2.3 Operational History and Waste Characteristics

During a bankruptcy sale that took place in 1968, Conrad Wesselhoeft purchased the CAF site. The CAF site was previously owned by Cracker Asphalt Company, an asphalt refining and storage company. The Cracker Asphalt Company left behind warehouses, shops, various types of petroleum and asphalt processing equipment, a cooling pond, a sediment pond and several large above ground storage tanks. After purchasing the property, Mr. Wesselhoeft's metal fabrication business made use of the office, shops, warehouses and much of the open space on the site. Mr. Wesselhoeft also has occasionally leased one of the tanks (350,000 gallon capacity) on the site to Southern Resins Company (EPA ID #: ALD004034138) for storage of by-product petroleum solvents.

The possible sources of the documented and suspected contamination coming from the CAF site include a sludge pond, a cooling pond, two asphalt skimmer trenches, a tank that has occasionally been used to store petroleum solvents, and several other tanks that have not been used since the bankruptcy of the Cracker Asphalt Company.

3.0 GROUND WATER

3.1 Hydrogeology

The CAF site and the surrounding area lie within the Alluvial-Deltic Plain district of the East Gulf Coastal Plain physiographic section. The prominent physiographic feature of this area is the broad, well developed, flat flood plains and terraces that have been formed by the meandering Black Warrior River. (Reference 5, p. 3)

The geologic units that outcrop in Moundville and the surrounding area are of sedimentary origin and consist of gravel, sand, silt and clay (Reference 6, p. 3-4). At the CAF site, alluvium and terrace deposits of Quaternary age overlie the Cretaceous age Gordo and Coker formations of the Tuscaloosa Group (Reference 5, p. 6-8).

The Quaternary flood plain deposits can be as much as 100 feet thick, and consist mainly of gravel, sand, silt and clay (Reference 7, p. 12). The Gordo Formation, which lies beneath the flood plain deposits, is as much as 400 feet thick, and consist of sand and gravel overlain by alternating lenticular beds of sand and mottled clay (Reference 5, p. 6-8 and 21). The Coker formation, which lies beneath the Gordo Formation, ranges in thickness from less than 100 feet to up to 1,000 feet. The Coker Formation consists of a nonmarine zone of gravel overlain by marine sand and clay. The nonmarine basal zone is generally separated from the marine sand beds by 50 feet or more of clay (Reference 5, p. 8).

Sand and gravel beds of the Tuscaloosa Group are the major sources of ground water in the study area. Alluvium and terrace deposits may also contain sand and gravel aquifers that are capable of yielding enough water for a private domestic or stock supply. (Reference 5, p. 12-15)

According to the outcrops along the river bank north of the site (Figure 4) and the bore hole logs from the property west of the site (Attachment 6), the terrace deposits consist of an upper fine-grained unit and a basal coarse-grained unit that lies unconformably atop the eroded remnants of the Gordo Formation. The base of the terrace deposits is considered to be the lowest occurrence of gravel.

The Gordo Formation, as seen in the bore hole logs (Attachment 6), consist of an upper unit of sand having zones of high iron content intermingled with layers of sandy clay and clayey sand and a basal unit of fine to medium sand. The contact between the Gordo Formation and the Coker Formation, as seen in the outcrops along the river bank, is a 1/2 inch layer of iron cemented sandstone underlain by massive red, purple, gray and brown mottled clay.

The terrace and Gordo deposits thicken in a westward direction and are estimated to 35 to 120 feet in thickness underneath the CAF site.

3.2 Ground Water Targets

There are many private wells and two public water supply wells within the 4-mile ground water target radius (Attachment 1; Attachment 2; Plate 1). The water from the two public water supply wells are blended together to make up 100 percent of the Moundville Water Works system. The Moundville Water Works has 1,348 connections on its system. The Moundville Water Works also sells 300,000 gallons of water per day to the Hale County Water System (Reference 8).

The Hale County Water System purchases 40 percent of its systems water from Moundville Water Works and 60 percent from Greensboro Water System. The water that the Hale County Water System buys is blended together before it is used by 2,500 purchasers. (PA # 6243, Att. 5 & 6)

3.3 Ground Water Sampling Data

MONITORING WELLS SAMPLED OFF-SITE

(maximum concentration found in each well)

Constituent (ug/l = ppb)	Well Number										
	1	2	3	4	5	6	8	9	10	11	12
Benzene	---	---	---	---	105	379	7	---	44	232	133
Ethylbenzene	---	---	---	---	78	186	---	---	120	860	395
Napthalene	---	---	23	---	805	10100	39	17	2760	5590	1360
N-Propylbenzene	---	---	---	---	26	46	---	---	45	439	129
Styrene	10	7	---	---	16	328	---	---	152	815	339
Toluene	---	---	---	---	28	41	---	---	46	162	127
1,2,4-Trimethylbenzene	---	---	6	---	134	2700	11	9	715	5240	1850
1,3,5-Trimethylbenzene	---	---	---	---	46	347	---	---	199	1610	290
Total Xylene	---	---	19	---	361	1900	12	7	462	4760	5230
Dicyclopentadiene	---	---	22	---	26	1540	8	5	943	656	186

(see Appendix A for more data on these wells)

MONITORING WELLS SAMPLED ON-SITE

Constituent (ug/l = ppb)	Well Number				
	CA-MW1	CA-MW2	CA-MW4	CA-MW5	CA-MW7
1,2,4 - Trimethylbenzene	111.1	50.6	1.6	---	---
Benzene	139.9	37.5	---	---	---
Ethylbenzene	121.9	---	---	---	---
m+p Xylene	57.6	20.8	---	---	---
Naphthalene (VOC)	1134.0	662.7	---	1.7	0.9
Toluene	13.2	7.5	---	---	---
n - Propylbenzene	---	53.2	0.8	---	---
o - Xylene	---	88.0	---	---	---
Naphthalene (BNA)	558.69	338.064	---	---	---

(see Appendix B for more data on these wells)

3.4 Ground Water Conclusion

While there is evidence that the Terrace/Gordo aquifer at the CAF site and the adjacent Lawter site is contaminated, the likelihood of any known municipal wells becoming contaminated is thought to be minimal because: 1) The nearest public well is greater than a mile to the southwest of the site. 2) The flow direction of ground water in the shallow terrace deposit aquifer beneath the CAF site is thought to be towards the Black Warrior River and not towards the either one of the public wells. 3) The contaminated aquifer is horizontally discontinuous in nature and the aquifer discharges its ground water to the surface in areas where errosional features have cut the land surface to a depth below the Terrace/Gordo aquifer. 4) The public water supply wells located within the 4-mile target radius are screened in the Coker aquifer and not the Terrace/Gordo aquifer. 5) The upper units of the Coker Formation are massive clays that help protect the aquifer from the contaminants above. 6) The Coker aquifer has a higher water pressure than the Terrace/Gordo aquifer above. Therefore, ground water from the Terrace/Gordo aquifer can not migrate downward into Coker aquifer.

4.0 SURFACE WATER PATHWAY

4.1 Hydrologic Setting

The CAF site is outside of the 100-year flood plain (Reference 9) at an elevation of approximately 170 feet above mean sea level. The northern most part of the site is the lowest portion of the site. The northwest corner of the site has a 60 to 65 foot vertical drop-off to the Black Warrior River that makes it very unlikely that the river will overflow its southern bank in the vicinity of the site.

Overland drainage from the CAF site exits the site via 3 somewhat well defined discharge points as well as many other less defined points. The most probable point of entry (PPE) for any contaminated overland drainage from the site to enter into the surface water pathway is southwest of the site at a point on Carthage Branch. The previously mentioned PPE is approximately 1/10 a mile upstream of The Black Warrior River. The closest PPE is at the northwest corner of the site at the point where the CAF site meets with the Black Warrior River. In either case, once the overland drainage enters the Black Warrior River it remains in the river for the remainder of the targeted 15-mile downstream surface water pathway.

The CAF is located within the Black Warrior River Basin. The lowest flow to which the river will decline during 7 consecutive days on an average of once every 2 years of normal flow (7-day Q2) is 935 cubic feet per second (Reference 10, p. 13-14).

4.2 Surface Water Targets

The 15-mile downstream surface water pathway (SWP) begins and ends on the Black Warrior River. There are no known drinking water intakes located along the SWP (Attachment 1). Approximately 26 of the 30 miles of river bank land along the SWP is considered to be wetlands (Attachment 3; Attachment 4; Plate 1). The adjacent wetlands to the east and the land along the surface water pathways may also be critical to the support of many threatened and endangered species (Attachment 3; Attachment 5).

4.3 Surface Water Sampling Data

SPRING SEEPS, SURFACE WATER AND WASTE WATER SAMPLED

Sample Number	Date	Contaminant	Concentration (ppb)
Seep A	11/85	Total Xylenes	1.1
Seep B	11/85	Chloroethane	7.5
Seep C	11/85	Chloroform	4.7
North Bluff Seep Middle	11/85	Benzene Toluene Ethyl Benzene Styrene Total Xylenes 1,3-Cyclopentadiene Propyl Benzene	150 28 54 37 320 3.9 19
North Bluff Seep West	11/85	VOC's	BDL
Lagoon	9/95	VOC's & BNA's	BDL
Tank Berm	9/95	VOC's & BNA's	BDL
T Pipe Discharge	9/95	VOC's & BNA's	BDL
Skimmer Trench	9/95	VOC's & BNA's	BDL
Drum West Berm	9/95	1,2,4 - Trimethylbenzene 1,3,5 - Trimethylbenzene m - Dichlorobenzene m + p Xylene Naphthalene (VOC's)	1055.0 313.72 32.56 1119.4 833.0

		0 - Xylene Naphthalene (BNA's)	1029.0 1013.1

(see Appendix C & D for more data on surface water samples)

4.4 Surface Water Conclusion

There is a good likelihood that contaminants from the CAF site have been released into the surface water pathway by means of both overland drainage and ground water to surface water discharge. The fisheries, wetlands and possibly critical habitats located along the 15-mile downstream surface water pathway (Reference 11, Attachment 3; Attachment 5), could be affected by contaminated ground water that is being discharged from seeps located along the south bank of the Black Warrior River and the east bank of Carthage Branch (Attachment 6; Appendix C).

5.0 SOIL EXPOSURE AND AIR PATHWAYS

5.1 Physical Conditions

Except for gates at all road entrances to the site, the CAF site has no manmade barricades to detour or prevent public access. Due to the natural river barrier north of the site and the expansive swamp and forest land to the east and northeast, most access to the site would occur along the south and west borders of the site.

The USDA Soil Survey indicates that the site is underlain by Bama Series soils. The soils of this complex are formed from loamy marine sediments of fine sandy loam, loam and sandy clay loam texture. The Bama series consist of deep, well drained, moderately permeable soils that have a moderate available water capacity. Runoff is medium. (Reference 4, p. 13, 54 and Sheet Number 100)

5.2 Soil Sampling Data

SOIL, SEDIMENT AND WASTE SAMPLED ON-SITE

Sample Number	Contaminant (ug/g = ppm)	Concentration (ppm)
East Tank Sample 1	Toluene	0.27
East Side Flow	1,2,4 Trimethylbenzene	0.33
East Side Flow	1,3,5 Trimethylbenzene	0.36
East Side Flow	Toluene	0.46
Skimmer Trench	Toluene	2.0
Lagoon 1	1,2,4 Trimethylbenzene	1.7
Lagoon 1	1,3,5 Trimethylbenzene	0.18
Lagoon 1	Ethylbenzene	0.23
Lagoon 1	Isopropylbenzene	0.17
Lagoon 1	Naphthalene	48.3
Lagoon 1	n- Propylbenzene	0.81

(see Appendix E for more soil and sediment sample data)

5.3 Soil and Air Targets

There are approximately 20 people working on the CAF site, 60 people working at the adjacent Southern Resins Company and approximately 3 people living within 400 feet of the site. The nearest school, Moundville Elementary, is approximately 7/8 of a mile to the southwest of the site (Reference 12). No daycare facilities were seen within 1/2 of a mile of the site during the PA site reconnaissance. According to the Alabama 1990 census records (Reference 3), the average number of people living in homes located in the counties of Hale and Tuscaloosa is 2.685 residents per household. In the following table, the total population within the target area has been broken down into sub-populations that live within the specified distance radius from the site:

DISTANCE FROM SITE	POPULATION
0 TO 1/4 MILE	3
>1/4 TO 1/2 MILE	6
>1/2 TO 1 MILE	453
>1 TO 2 MILES	821
>2 TO 3 MILES	629
>3 TO 4 MILES	558
TOTAL POPULATION	**2470**

None of the CAF site is considered to be a wetland environment. Within the 4-mile target area and the 15-mile surface water pathway are many wetland areas. The nearest wetlands are northwest of the site along the banks of the Black Warrior River. Approximately 35 percent of the total area within one mile of the site may possibly be considered wetlands.

It is not known if the CAF site itself is a critical habitat for federally designated endangered or threatened species. Attachment 3 and Attachment 5 list all of the endangered or threatened species that may utilize the land and surface waters located within the specified target areas.

5.4 Soil Exposure and Air Pathway Conclusion

Due to the Characteristics of the waste present at the CAF site, the soil and air exposure may pose a moderate threat to human health, wildlife and the environment. There are 20 workers employed at the site and the presence of a Native American burial mound on the north end of the site makes the site somewhat likely to be traveled across by trespassers.

6.0 SUMMARY AND CONCLUSION

The Cracker Asphalt Company operated an asphalt refining and storage company at the site in the late 1960's. During a bankruptcy sale that took place in 1968, Conrad Wesselhoeft purchased the old CAF site and started a metal fabricating business that produces metal tank heads and large boat anchors. Leakage and spillage from asphalt and diesel fuel storage tanks are believed to be the sources of known ground water and surface water contamination.

ADEM is currently planning to sample soil, ground water and surface water at the CAF site in order to determine if the source of contamination is the Cracker Asphalt site, the Lawter site or a combination of these two adjoining sites. Based on the current analytical data and the visible state of the Cracker Asphalt site, ADEM recommends that that the site be further evaluated in order to determine what true threats the site poses on human health and the environment.

REFERENCES

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2. U.S. Environmental Protection Agency, Standard Operating Procedure to Determine Site Latitude and Longitude Coordinates, 1991. Calculation worksheet for the Cracker Asphalt Site.

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4. Johnson, Kenneth W., et al., United States Department of Agriculture Soil Conservation Service and Forest Service in cooperation with Alabama Department of Agriculture and Industries and Alabama Agricultural Experiment Station, 1981, Soil Survey of Tuscaloosa County, Alabama.

5. DeJarnette, Sydney S., and Crownover, Jo E., 1987, Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama; Area 6: U.S. Geological Survey Water-Resources Investigations Report 87-4113.

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7. Mooty, Will S., 1987, Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama; Area 7: U.S. Geological Survey Water-Resources Investigations Report 87-4109.

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9. Federal Emergency Management Agency, Flood Insurance Rate Maps, Hale and Tuscaloosa Counties; Moundville, Alabama. Panel Number 010096 0005 B.

10. Moore, James D., et al, Geological Survey of Alabama, 1991, Water in Alabama, 1990: Circular 122H.

11. Alabama Department of Environmental Management; Water Division - Water Quality Program, 1993, Water Use Classification for Interstate and Intrastate Waters, Chapter 335-6-11.

12. State of Alabama-Department of Education, LEA Personnel System (EDLP471), 1992, Total Number of Pupils and Faculty by School and County.

REFERENCE

4

Tuscaloosa County

GIS Internet Report

Ownership Information

Parcel Number:	43-09-31-0-001-005.000
Year:	2010
Owner:	SMALLEY ANNE WESSELHOEFT AS
In Care Of:	SARA J SMALLEY THE LAST WILL AND TESTAMENT OF MARITAL TRUST CREATED UNDER TRUSTEE OF THE NON-EXEMPT
Street:	1209 INDIAN HILLS CIR
City:	TUSCALOOSA
State:	AL
Zip:	35406
A/K/A:	
Property Location:	CRACKER ASPHALT RD
Tax District:	6
Fire District:	
Deed Date:	9/30/2003
Deed Book & Page #:	2003-18541
Plat Book & Page Number:	-
Subdivision:	
Block:	
Lot:	
Calculated Acreage:	8
Deed Acreage:	0

Tuscaloosa County

GIS Internet Report

Assessment Information

Parcel Number: 43-09-31-0-001-005.000 **Year:** 2010

	CLASS CODE	MARKET	CODE	DESCRIPTION	MARKET-EXEMPT	TAXABLE	ASSESSED VALUE
Improvement:	2			73060	0	365,300	365,300
Land:	2			24900	0	124,500	124,500
TOTALS:					0	489,800	489,800

Current Use Value: 0

Industrial Exempt/Abatement Value: 0

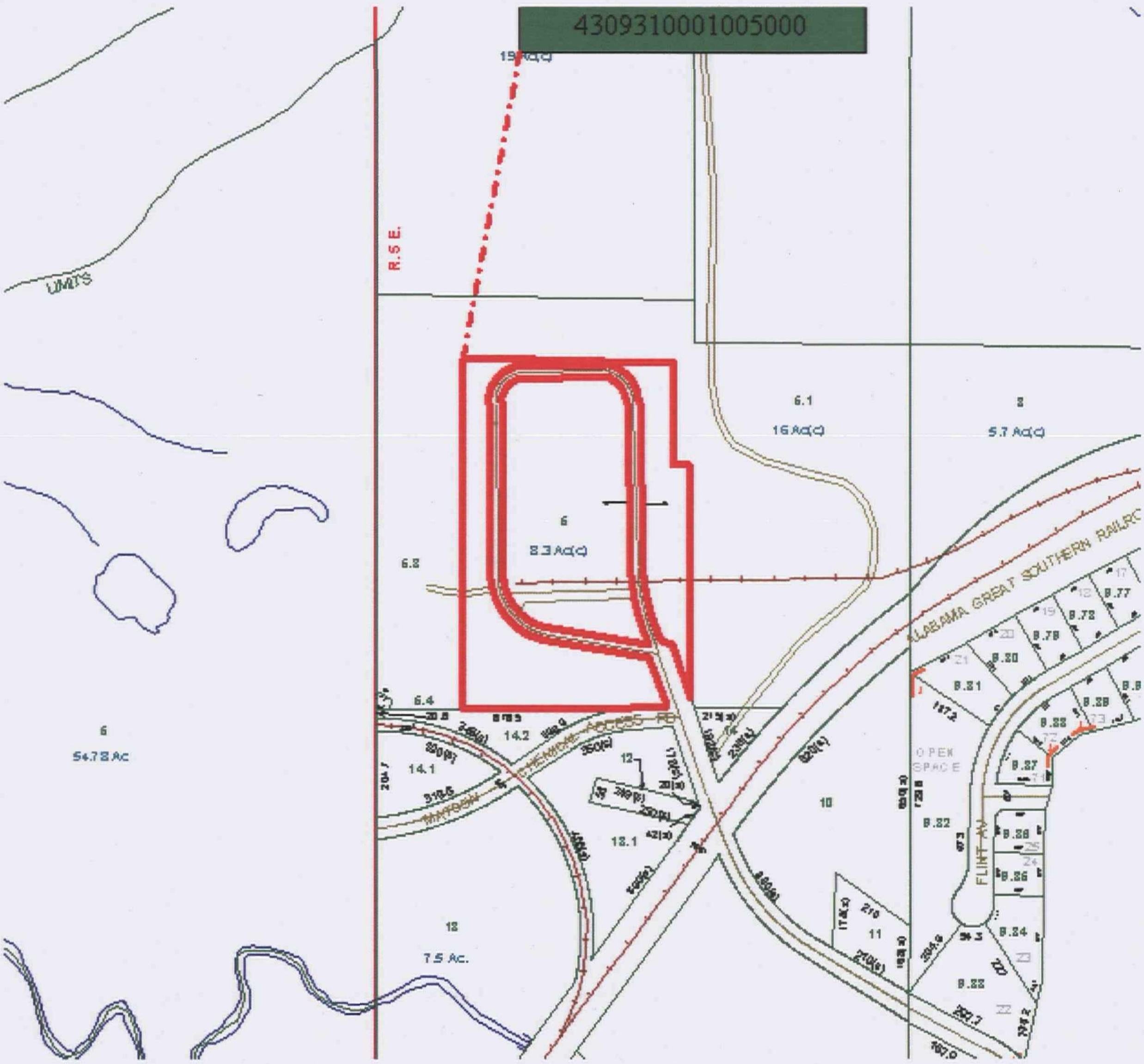
Penalty: 0

Total Assessed Value: 97,960

Tuscaloosa County

GIS Internet Report

Map Information



Tuscaloosa County Disclaimer

Information deemed reliable but not guaranteed.

REFERENCE
5

Eastman Chemical Company
P. O. Box 511, B-54D
Kingsport, Tennessee 37662-5054
Telephone: 423-229-1863
Fax: 423-229-4864
e-mail: rguinn@eastman.com

EASTMAN

CERTIFIED MAIL

January 16, 2006

Mr. Emmett Hampton
Alabama Department of Environmental Management
Site Assessment Unit, Land Division
P.O. Box 301463
Montgomery, AL 36130-1463

Re: 2005 Groundwater Monitoring Report
Former Eastman Resins Site (fka Lawter International)
Moundville, AL

Dear Mr. Hampton,

In 2002 Eastman Chemical Company (Eastman) ceased operation of the Eastman Resins, Inc. manufacturing facility located in Moundville, Alabama (fka Lawter International). In 2003 a closure of the wastewater treatment impoundments and termination of the site's NPDES permit was completed and approved by ADEM and the site was sold. As part of the closure plan Eastman agreed to continue semi-annual monitoring of specific groundwater wells for the previously identified constituents of potential concern (COPCs) to evaluate the effectiveness of the wastewater impoundments closure, and for ongoing monitoring of the natural attenuation of the COPCs in the area of a historical release on the interior of the property. For your reference, Section 5 of the closure plan (Groundwater Evaluation and Protection) is enclosed which details the monitoring plan, compliance wells, and compliance limits that were agreed upon in the closure plan.

The monitoring and analyses of the COPCs during 2005 was conducted by TTL, Inc. Enclosed are the groundwater monitoring reports for the two sampling events of 2005. To briefly summarize the data for 2005, the two down gradient compliance determination wells (MW-3 & MW-4) showed non-detect values for all parameters with the exception of one low level detection (7 ug/L) of dicyclopentadiene in MW-4. MW-3 has been consistently at non-detect for all COPCs since 2003, and MW-4 has been at or around non-detect for all COPCs since mid 2004. Additionally, the down gradient well closest to the former wastewater impoundments which were closed and capped (MW-5D) continues to show significant improvement with only one detectable constituent (naphthalene, 17 ug/L) occurring during the most recent sampling event. Many COPCs have been non-detect at this well since 2004.

It is important to note that all of the COPCs detected exhibited concentrations that are orders of magnitude below the compliance limits established in the closure plan, and all of the down gradient wells showed dramatic improvements over the higher concentrations that appeared during the excavation of the wastewater impoundments in 2003. Trend graphs of the COPCs

Responsible Care

concentrations for the down-gradient wells from the period of the wastewater impoundment excavation through the end of 2005 are attached.

The up gradient well (MW-11) closest to the site of the historic release that occurred prior to Eastman's ownership of the property continues to show significant, consistent improvements due to natural attenuation. Graphs of the historical and recent COPCs concentrations for this well are also attached which shows trends of decreasing concentrations for all constituents.

According to the Closure Plan approved by ADEM, Eastman is authorized to request a reduction or elimination of the groundwater monitoring program if monitoring indicates a trend of decreasing concentrations of COPCs, or continues to indicate no potential to exceed any water quality standards, criteria, or ecological screening values for a period of two years after the closure has been completed. The two years of monitoring since completing the closure has now occurred and Eastman is formally requesting to discontinue groundwater monitoring at the site. The monitoring data supports continual improvements and that no COPCs are appearing at the down gradient wells at concentrations of concern. In fact, nearly all of the constituents are now at non-detect levels in those wells, and have been at non-detect for some time.

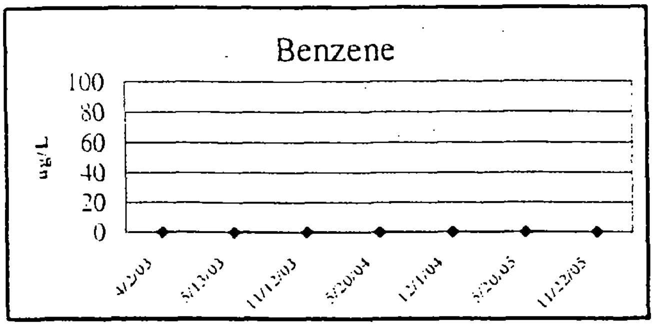
Based on existing data, the COPCs remaining in up gradient well MW-11 are not migrating toward the down gradient compliance wells, where historical potentiometric flow direction data indicates they should be detected if present. With no significant concentrations appearing in the down gradient wells over a period of historical groundwater monitoring data of greater than twenty years, it is apparent that the remaining contamination is confined within the property boundaries and continues to demonstrate a consistent downward concentration of COPCs due to natural attenuation. The removal of the wastewater impoundments and an impermeable capping of that area has also improved the situation by decreasing the flow to groundwater of any potential sources of COPCs. This can be seen from the continual improvement of data from well MW-5D. Based on this compelling data Eastman respectfully requests ADEM consent to terminate our groundwater monitoring program, as authorized by the closure plan.

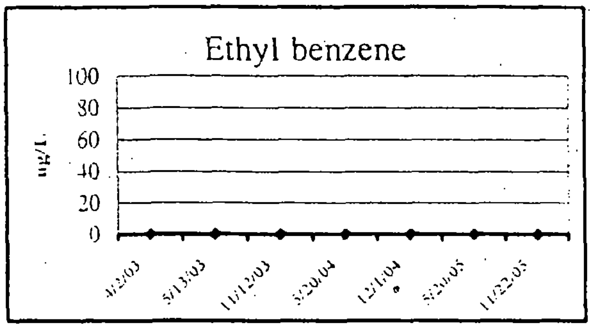
Eastman appreciates your review of this monitoring data and awaits your decision on our request to terminate groundwater monitoring at this site. If you have any questions or concerns, please feel free to contact me.

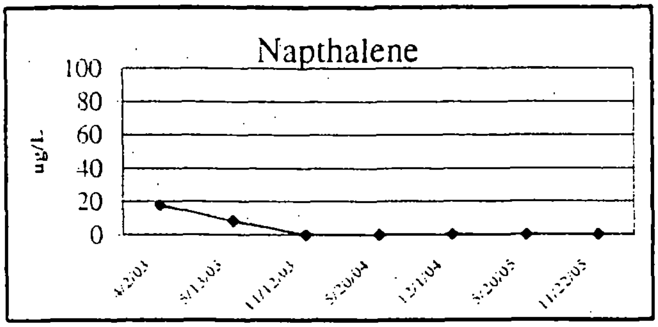
Richard J. Guinn, Ph.D.
Technical Associate

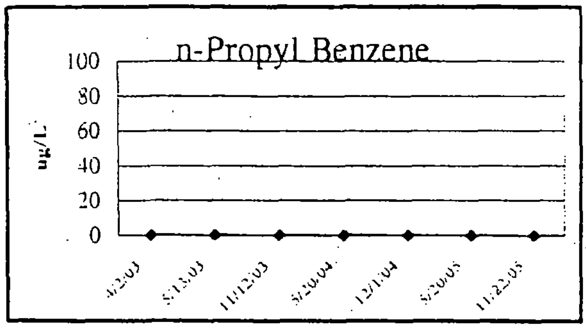
cc: Mr. Wayne Holt, Water Division, Industrial Section

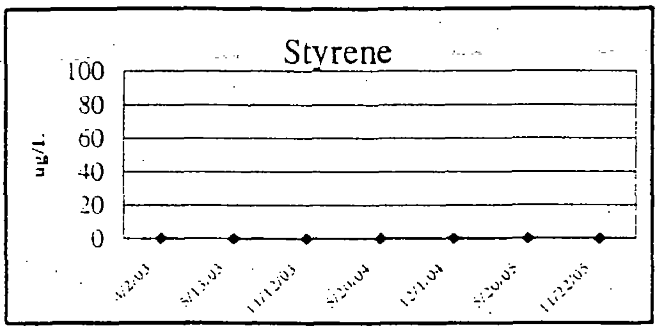
Down Gradient Compliance Well MW-3
COPC Trends From 2003 - 2005

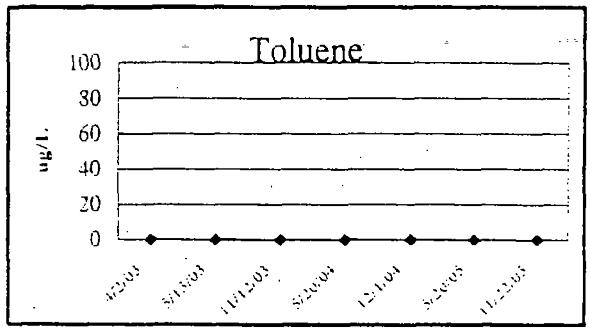


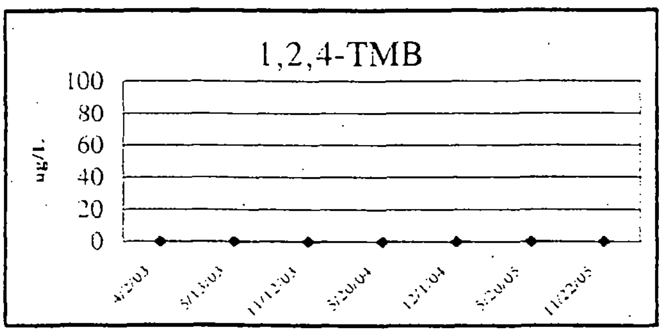


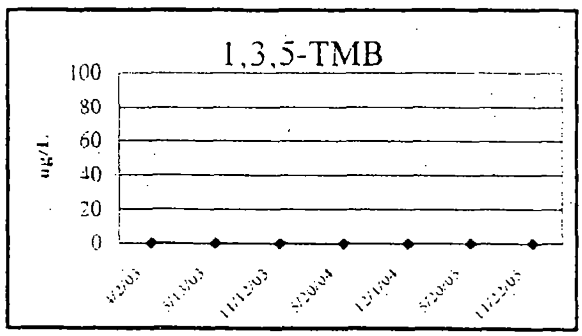


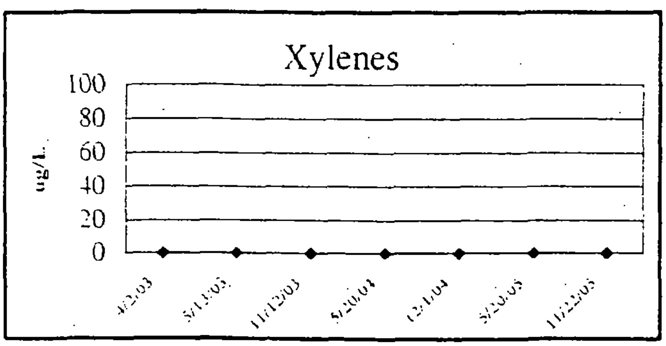


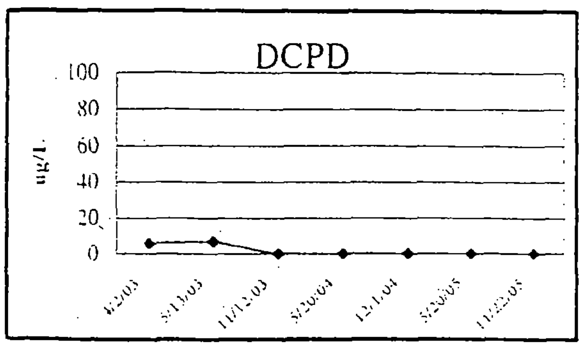








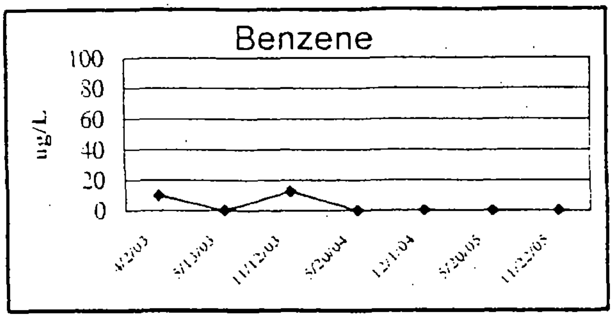


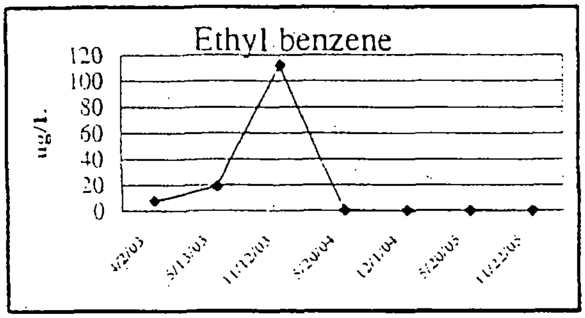


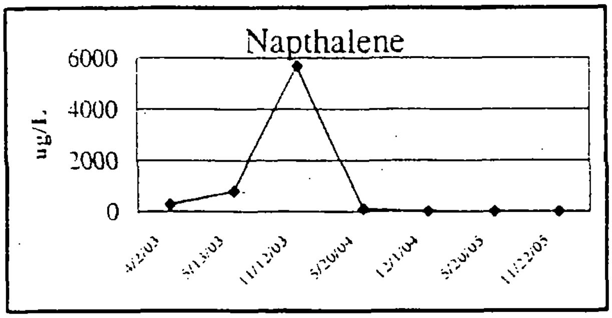
Note: Values indicated as zero on the graph are analytical results below the detection limit.

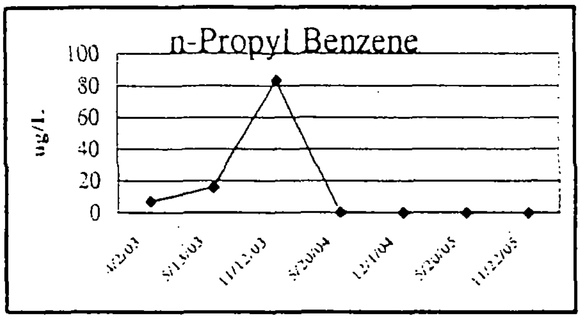
Down Gradient Compliance Well MW-4

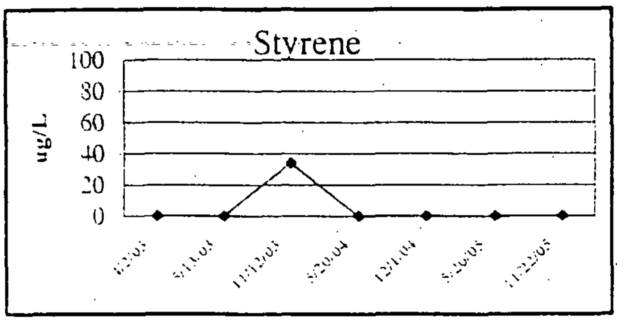
COPC Trends From 2003 - 2005

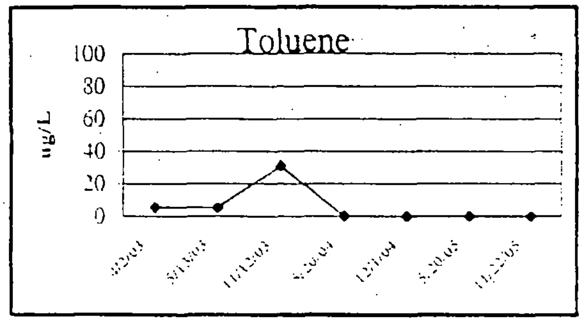


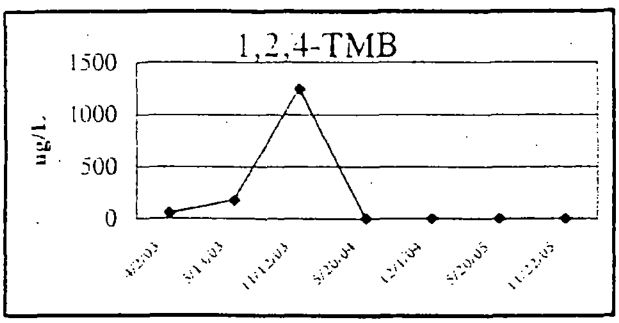


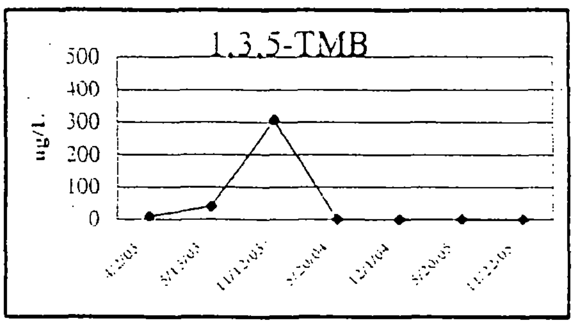


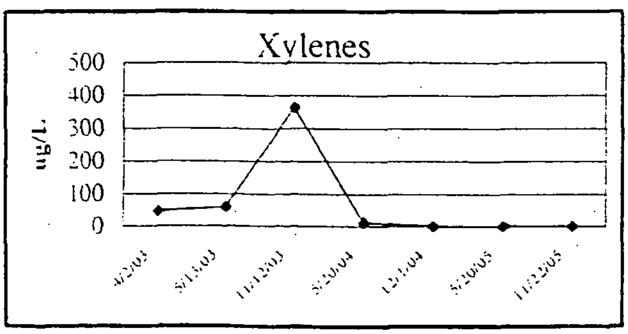


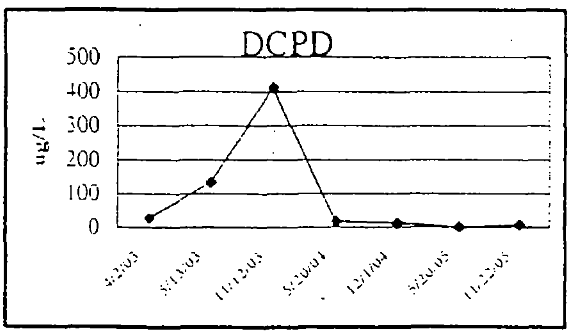








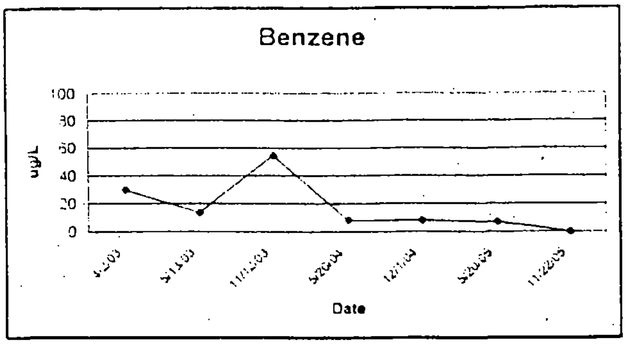


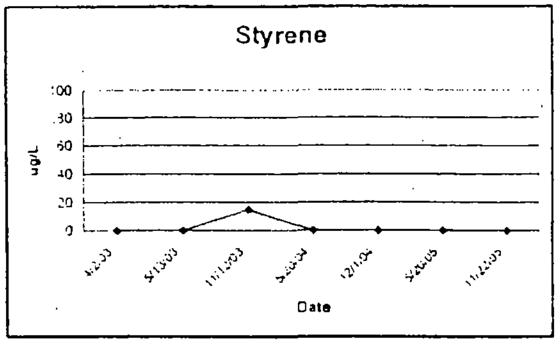


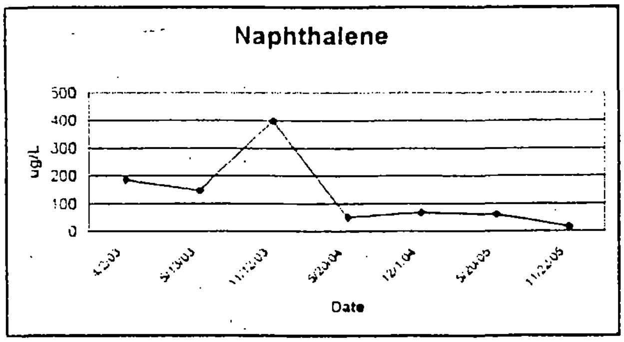
Note: Values indicated as zero on the graph are analytical results below the detection limit.

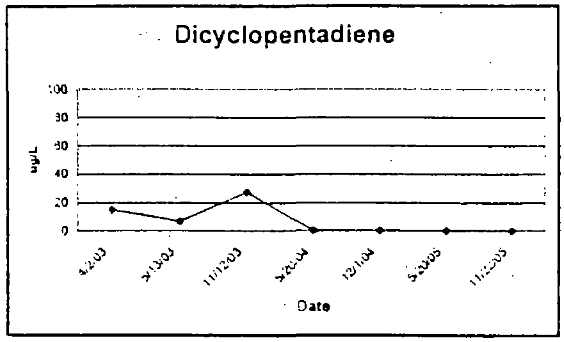
Down Gradient Well MW-5D

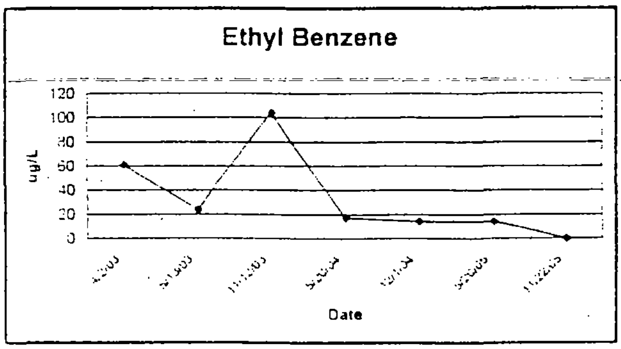
COPC Trends From 2003 - 2005

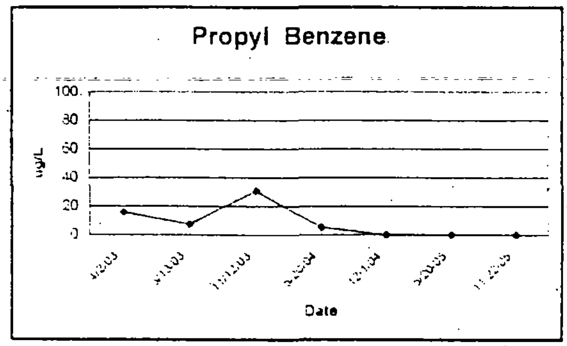


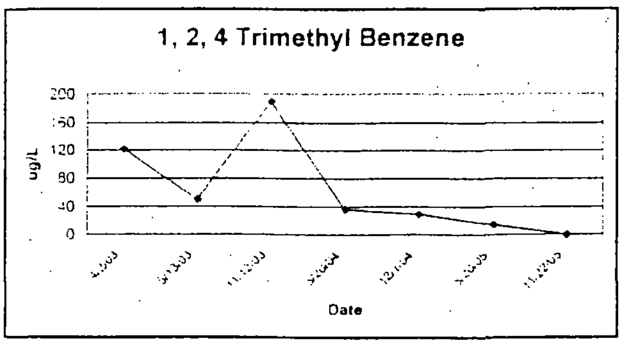


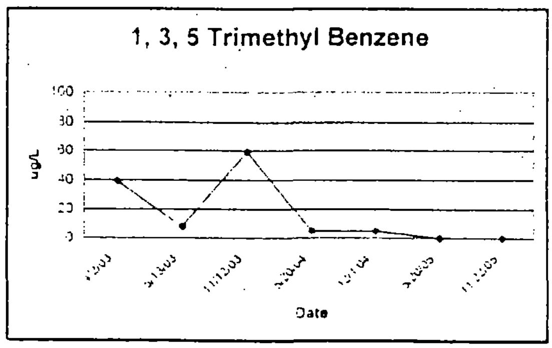


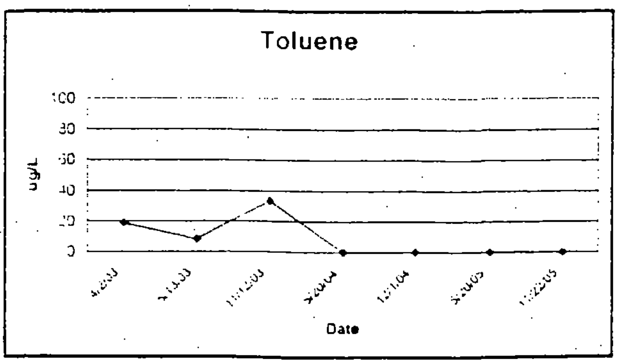


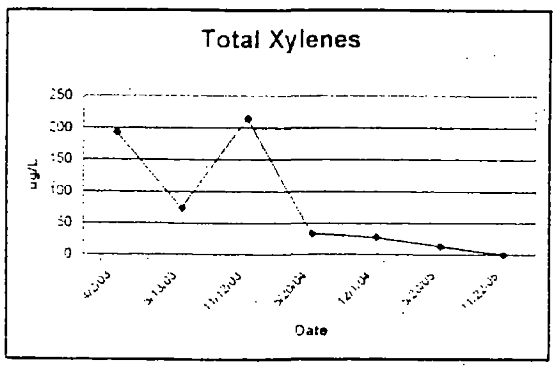










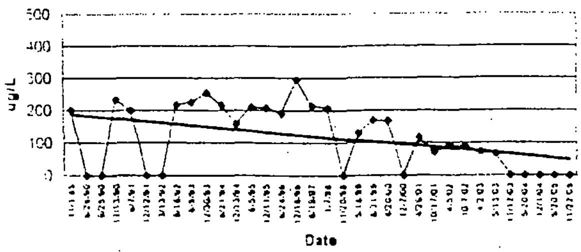


Note: Values indicated as zero on the graph are analytical results below the detection limit.

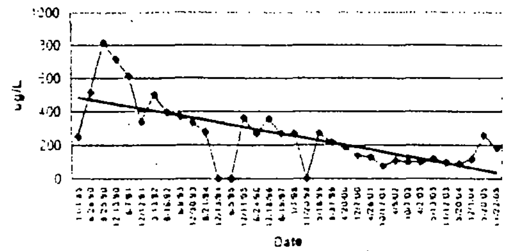
Up Gradient Well MW-11

COPC Trends From 1985 - 2005

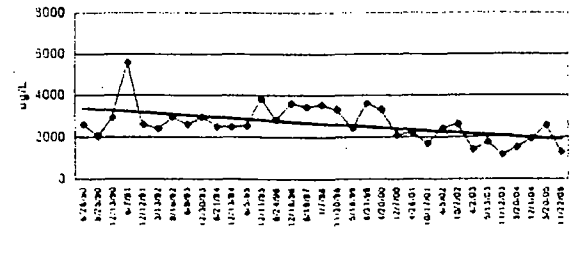
Benzene



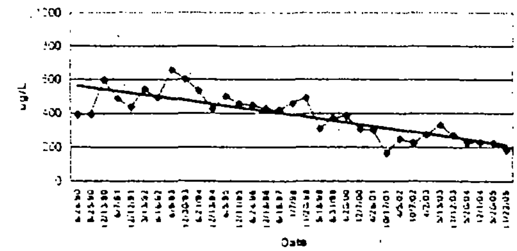
Styrene



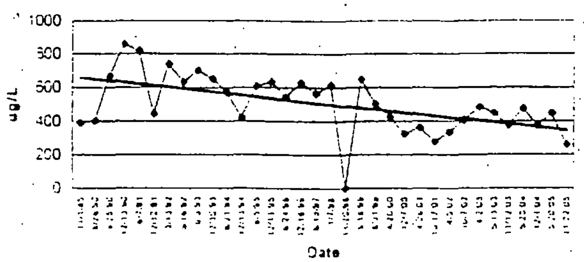
Naphthalene



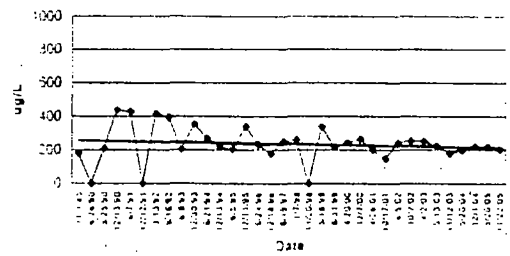
Dicyclopentadiene



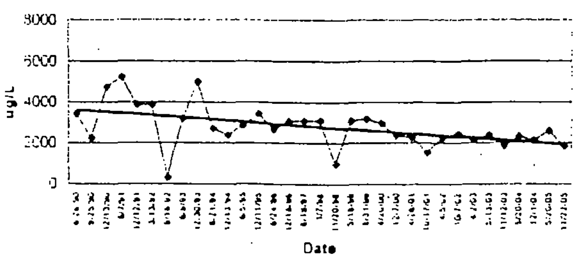
Ethyl Benzene



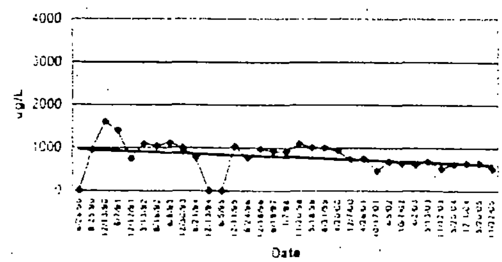
Propyl Benzene



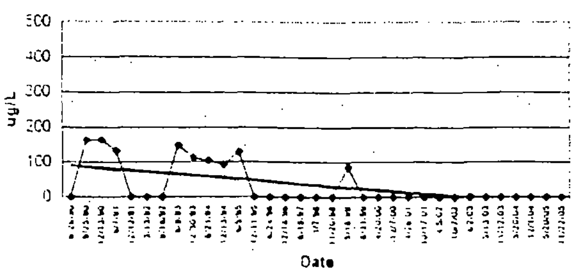
1, 2, 4 Trimethyl Benzene



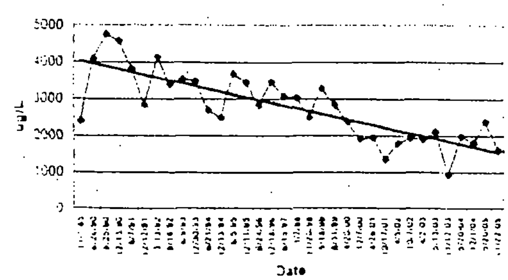
1, 3, 5 Trimethyl Benzene



Toluene



Total Xylenes



The area will be seeded and water will be applied as necessary to the seeded surface to encourage germination of the seed mixture. If large seeded areas do not germinate, the process described above (or a modified process) will be repeated in those locations until germination occurs.

During the final grading and vegetation procedures, silt fencing will be installed, as appropriate, to maintain storm water control in accordance with best management practices (BMPs).

4.2.2: Institutional Controls to Protect Closure Area

It is anticipated that long-term maintenance of the area will be minimal and will include only mowing the grass in the area, as appropriate, for the future use of the site. It is Eastman's intentions to divest itself of this property while indemnifying the new owner from environmental liabilities attributable to pre-closing operations for a certain period of time. Deed restrictions will be placed on the property that will prevent excavation or inappropriate development of the closure area. Other deed restrictions will stipulate that that wells for drinking or industrial use cannot be drilled on the property, and the property cannot be used for residential purposes.

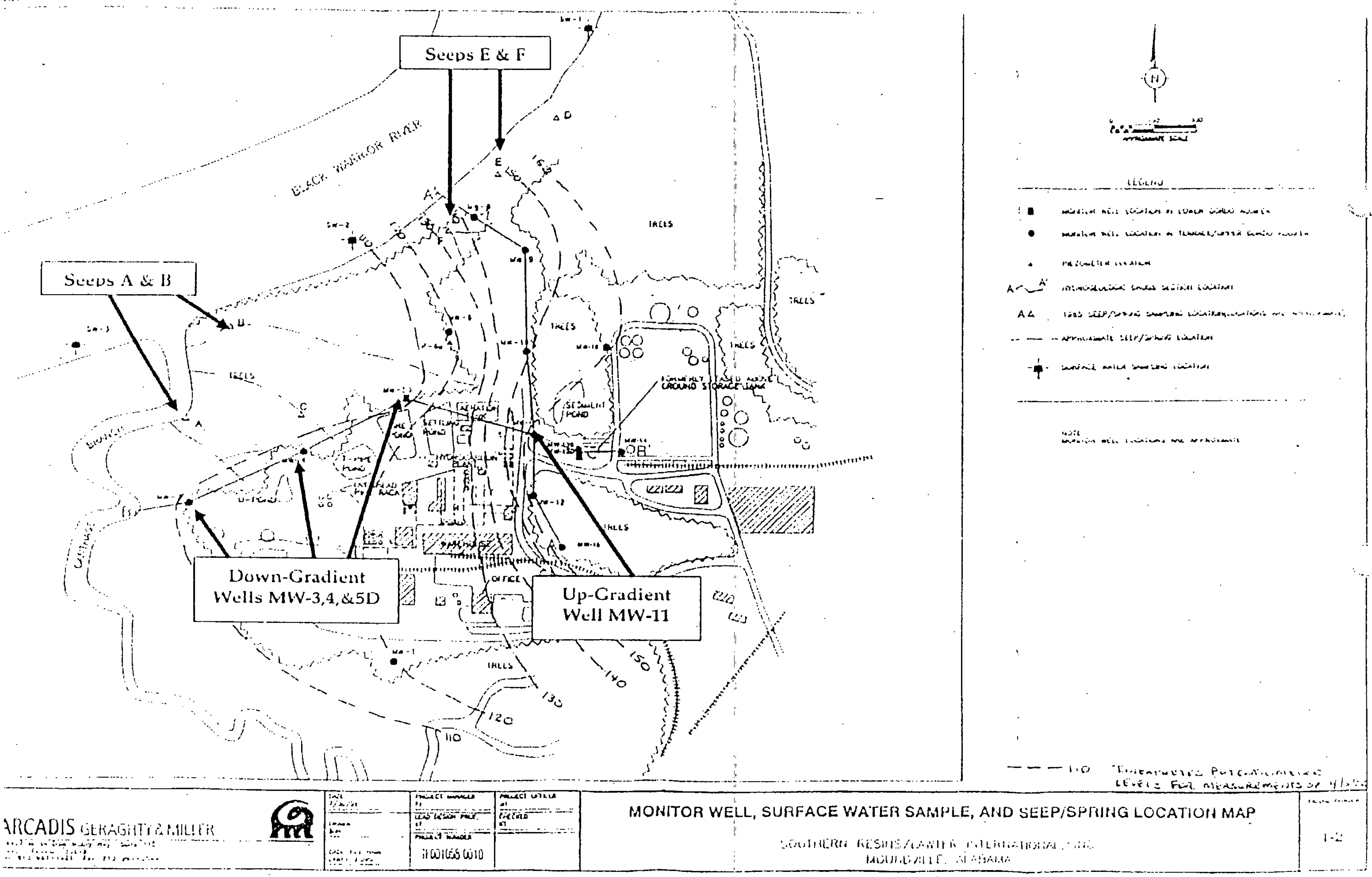
Section 5. Groundwater Evaluation and Protection

5.1: Historical Groundwater Monitoring and Risk Assessments

Semi-annual groundwater monitoring has been conducted at this site since 1991 for constituents of interest (COIs) determined by ADEM. The COIs monitored are the same materials identified as the COPCs proposed for the impoundment closure in Table 3.2. A July 1999 Groundwater Assessment Report and a November, 1999 Risk Assessment Report prepared by ARCADIS Geraghty & Miller were submitted to ADEM in response to elevated COIs on the eastern edge of the facility that ADEM believed was coming from a storage tank formally leased by Lawter International for storage of a Lawter co-product. Those reports, contained in Attachment B, provide a detailed description of the site hydrogeology, as well as a risk assessment for the groundwater COIs conducted at that time. The locations of monitoring wells and seeps are shown in this report as Figure 5.1.

The reports reached the same conclusions put forth by ADEM that the suspected source of the groundwater COIs was the storage tank on the property adjacent to the eastern edge of the Lawter facility. The risk assessment concluded that the groundwater contamination did not pose health risks to receptors. It is also important to note that the wastewater treatment impoundments were not implicated as sources of the groundwater contamination. This is due to the fact that the highest concentrations were all observed up-gradient from the impoundments. Monitoring wells (MW-3 & 4) and seeps (seeps A & C) down-gradient from the impoundments exhibited COI concentrations at or near their respective detection limits.

In a January, 2000 letter from ADEM's hydrogeologist, Joe Kelly, groundwater monitoring requirements were reduced to two wells and one seep, MW-5D, MW-11, and seep E. Monitoring well MW-11 was considered the well nearest the source of the contamination (source well). MW-5D, approximately 1000 feet down-gradient from the source, was ure 5.1 Groundwater Monitoring Wells and Seeps



considered a compliance point well, and seep E was the only seep monitored where elevated COIs were detected. Since the reports were issued in 1999, groundwater monitoring data from these wells and seep have shown a continued decreasing trend for the COIs .

5.2: Closure Risk Assessment

Exposure pathways for the site have been evaluated to determine if there is a potential for exposure. The evaluation determined that direct contact with soil is unlikely as the impoundments will be backfilled and the contaminated soils will be a considerable depth below grade prior to capping the area. Direct contact with groundwater is also unlikely, as the site is supplied with municipal water, and no water supply wells are located on, or are reasonably expected to be located on site. Risk assessments for the remaining various exposure pathways have been calculated. They include:

- Volatilization from subsurface soil to indoor air
- Volatilization from subsurface soil to outdoor air
- Volatilization from groundwater to indoor air
- Volatilization from groundwater to outdoor air
- Groundwater ingestion at the point of exposure, Carthage Branch and the Black Warrior River (discussed in Section 5.2.1)
- Ecological screening at the point of exposure, Carthage Branch and the Black Warrior River (discussed in Section 5.2.1)

Site specific risk based targets levels (RBTLs) were calculated for subsurface soil and for groundwater using the RM-2 equations in ADEM's ARBCA: Alabama Risk-Based Corrective Action Guidance Manual, December 20, 2001 (ARBCA). Volatilization factors from subsurface soil to indoor air and outdoor air, and from groundwater to indoor air and outdoor air were calculated. RBTLs were calculated for each site COPC in indoor and outdoor air. Only the commercial worker receptor was evaluated, as deed restrictions prohibiting use of the land for residential purposes will be implemented. Concentrations of each COPC in subsurface soil and groundwater were then back-calculated to determine levels which would not result in exceedences of risk based levels in indoor and outdoor air. All chemical specific parameters used in the calculation were from the ARBCA guidance document with the exception of DCPD and n-propylbenzene. However, as is pointed out on pages 29-30 of the ARCADIS report (Appendix B), the inhalation reference concentration value (RfC) for DCPD used in the calculation is very likely overly conservative. The NIOSH standard for DCPD in ambient air is 5 ppm (27 mg/m^3), as is the ACGIH standard. The standards are applicable to commercial worker exposure for eight-hour and 10-hour periods, respectively. In contrast, this risk assessment (also done for commercial worker exposure) used a RBTL for DCPD of 0.00409 mg/m^3, or over 1000 times lower than the NIOSH and ACGIH standards.

All default parameters used in the calculations were recommended by the ARBCA guidance document. The site specific, RBTLs for subsurface soil and groundwater are presented in Table 5.1. A comparison of the maximum detected concentrations observed in the remaining soils (Tables 4.1 & 4.2) indicates that potential risks are identified only for the non-carcinogenic, soils to indoor air exposure pathway. To eliminate this pathway a deed restriction preventing construction in this area will be implemented. For groundwater to indoor or outdoor air exposure pathways none of the values from recent monitoring data approached the target levels.

Table 5.1: Risk-Based Target Levels for Soil and Groundwater, Back Calculated from Risk-Based Concentrations in Indoor and Outdoor Air

Compound	Non-carcinogenic Risk-based TL SS to IA RBTLsi mg/kg	Carcinogenic Risk-based TL SS to IA RBTLsi mg/kg	Non-carcinogenic Risk-based TL GW to IA RBTLwi mg/L	Carcinogenic Risk-based TL GW to IA RBTLwi mg/L
Benzene	9.89	0.22	33.04	0.72
Dicylcopentadiene	2.15	NA	0.49	NA
Ethylbenzene	4269.15	NA	4957.53	NA
Naphthalene	1540.43	NA	208.05	NA
n-Propylbenezene	1582.33	NA	608.38	NA
Styrene	55563.71	NA	12512.44	NA
Toluene	1155.56	NA	1893.68	NA
1,2,4-TMB	233.76	NA	55.51	NA
1,3,5-TMB	173.20	NA	40.05	NA
Xylenes	1721.90	NA	1601.65	NA

Compound	Non-carcinogenic Risk-based TL SS to OA RBTLso mg/kg	Carcinogenic Risk-based TL SS to OA RBTLso mg/kg	Non-carcinogenic Risk-based TL GW to OA RBTLwo mg/L	Carcinogenic Risk-based TL GW to OA RBTLwo mg/L
Benzene	1057.61	23.04	3437.41	74.89
Dicylcopentadiene	266.52	NA	57.92	NA
Ethylbenzene	456369.69	NA	531639.96	NA
Naphthalene	164771.83	NA	16568.56	NA
n-Propylbenezene	142260.65	NA	62190.89	NA
Styrene	5940127.80	NA	1214556.68	NA
Toluene	123528.48	NA	201451.90	NA
1,2,4-TMB	24989.29	NA	5642.31	NA
1,3,5-TMB	18515.43	NA	4209.74	NA
Xylenes	184071.46	NA	169028.28	NA

NOTES: TL = target level; SS = subsurface soil; IA = indoor air; GW = groundwater; OA = outdoor air

Highlights indicate exceedances of target levels.

5.2.1: Soil to Groundwater Modeling

The soil to groundwater protection models appear to be overly conservative predictors, as the predicted concentrations of COIs in the groundwater do not correspond with the observed down-gradient monitoring well data (MW-3 & 4). The COPCs in the soils are legacy compounds that have likely been present for the entire period of use of the impoundments, yet the down-gradient wells indicate either non-detection levels of the COPCs or relatively low levels. Table 5.2 provides groundwater monitoring data from wells MW-3 & 4.

Table 5.2: COPC concentrations in Down-gradient Monitoring Wells MW-3 and MW-4

Monitoring Well MW-3

Date	Benzene	Ethyl benzene	Napthalene	n-Propyl Benzene	Styrene	Toluene	1,2,4-TMB	1,3,5-TMB	Xylenes	DCPD
11/01/85	ND	ND	NA	ND	ND	ND	NA	NA	ND	NA
06/26/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
09/25/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/13/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/07/91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/12/91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
03/13/92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
09/16/92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/09/93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/30/93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/21/94	ND	ND	22.6	ND	ND	ND	6.2	ND	18.6	22.1
12/13/94	ND	ND	ND	ND	ND	ND	5.31	ND	6.53	7.32
06/05/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/11/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/24/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/18/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/19/97	ND	9.4	106	ND	6.4	ND	29.7	8.6	68.7	29.9
01/07/98	ND	ND	18	ND	ND	ND	ND	ND	15	19.2
11/20/98	ND	ND	31	ND	ND	ND	5.5	ND	9.3	9.7
05/18/99	ND	ND	62	ND	ND	ND	16	ND	22	15
04/02/03	ND	ND	17.4	ND	ND	ND	ND	ND	ND	5.8

Monitoring Well MW-4

Date	Benzene	Ethyl benzene	Napthalene	n-Propyl Benzene	Styrene	Toluene	1,2,4-TMB	1,3,5-TMB	Xylenes	DCPD
11/01/85	ND	ND	NA	ND	ND	ND	NA	NA	ND	NA
06/26/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
09/25/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/13/90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/07/91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/12/91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
03/13/92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
09/16/92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/09/93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/30/93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
06/21/94	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/13/94	ND	ND	ND	ND	ND	ND	ND	ND	6.29	ND
06/05/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12/11/95	ND	ND	ND	ND	ND	ND	ND	ND	6.1	19.7
06/24/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	14.6
12/18/96	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
06/19/97	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.1
01/07/98	ND	ND	18	ND	ND	ND	ND	ND	5.9	8.2
11/20/98	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
05/18/99	6	ND	15	ND	ND	3	ND	ND	7	14
04/02/03	9.7	7.5	280	7	ND	5.6	54.1	9.8	46.6	26.9

Because the wells are also down-gradient of the storage tank identified as the historic source of groundwater contamination, it cannot be determined if the COPCs detected in these monitoring wells originated from the storage tank, the wastewater impoundments, or a combination of the two.

The recent sampling of the soils below the wastewater impoundments indicate that COPCs are also present and may also be an additional source of groundwater contamination. Potentiometric levels in groundwater monitoring wells indicate that the direction of groundwater flow from the wastewater impoundment area is primarily toward the Black Warrior River, with a slight potential to flow toward a short stretch of Carthage Branch at its intersection with the river. Sampling of Carthage Branch, three seeps located near the down-gradient boundary with Carthage Branch and along the river (A, B, & F), as well as the river immediately downstream of Carthage Branch was conducted in July, 2003 to determine if any of the COPCs were present at these locations. The seeps are located near the property boundary where groundwater discharges at the contact of the terrace deposits and the Gordo Formation. Seep A is located on the edge of Carthage Branch and would be considered the western edge of any down-gradient groundwater discharge to Carthage Branch. Seep B is located in the ravine designated as stormwater outfall DSN003, and is the seep most down-gradient from the wastewater impoundment area. Seep F is not down-gradient from the wastewater impoundments, but is down-gradient from the historical contamination site and between seep E, that is routinely monitored, and seep B. Carthage Branch was sampled at a point between seep A and the ravine serving the discharge of the T-Pipe Pond. This site was selected for sampling to prevent dilution from the stormwater being pumped from the T-Pipe Pond (DSN001) on the day of sampling. Flow in Carthage Branch on the day of collection was estimated to be 1200 gpm. The Black Warrior River was sampled approximately 40 feet downstream from where Carthage Branch joins the river at a site designated as SW-3 in Figure 5.1. The sample was collected just below the surface approximately 10 feet off the shoreline. This location would be the most likely area of the river to show any contamination from the combined discharges of groundwater flows to the river and Carthage Branch, as well as stormwater discharges from the site. The samples were collected and analyzed by TTL, Inc., a contract laboratory located in Tuscaloosa, Alabama. Table 5.3 presents the results of that sampling event. All COPCs were below the method detection limits.

With the capping of the area of the impoundments and institutional controls in place, the routes of human exposure to the COPCs become very limited. The cap over the affected area will further reduce migration of vapors to outdoor air. The cap and deed restrictions limiting activity in the area protect against direct exposure to the soils left in place beneath the cap. Groundwater is not currently used at the site and deed restrictions will prevent any future withdrawal of groundwater on the property, thereby making direct exposure to groundwater unlikely. Exposure to recreational users of the Black Warrior is unlikely as the only seep that has shown any detectable concentrations of the COPCs is seep E, and this seep is not easily accessible (addressed in the ARCADIS report). Recent sampling results from seep E (Oct. 2002 & April 2003) have also shown that COPCs at the seep were below detection limits. The only potential exposure route would be if groundwater concentrations increased to the point where significant levels flowed down-gradient to impact surface waters.

Table 5.3: July 2003 Monitoring of COPCs in Seeps A, B, & F, Carthage Branch, and the Black Warrior River (concentrations in ug/L)

COPC	PQL	Seep A	Seep B	Seep F	Carthage Branch	Black Warrior River (downstream)
Benzene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Toluene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Ethylbenzene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Xylenes (total)	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dicyclopentadiene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
n-Propylbenzene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Styrene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,4-Trimethylbenzene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,3,5-Trimethylbenzene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Naphthalene	5.0	<5.0	<5.0	<5.0	<5.0	<5.0

PQL=Practical Quantitation Limit

The sites recently sampled represent the water bodies to be protected, Carthage Branch and the Black Warrior River, and groundwater discharges from seeps at or very near the down-gradient property boundaries that have the potential to impact the surface water. The results of samples collected in Carthage and the Black Warrior River from table 5.3 were compared to the drinking water standards, water quality criteria, and chronic ecological screening levels listed in table 5.4. All of the COPCs were below the method detection limits and also below the lowest of the screening levels with the exception of dicyclopentadiene (DCPD), which has a drinking water standard that is below the practical quantitation limit (PQL) of the analytical method.

To assess whether there is a potential for an exceedance of the screening level for DCPD, a calculation was made to determine what concentration of DCPD in groundwater discharging to Carthage Branch would be required to exceed the very conservative drinking water standard screening level. The sampling of seeps A and B represent groundwater discharges from the boundary of the terrace deposits and the Gordo Formation, which would be most impacted by potential contamination from the wastewater impoundments. The calculation is provided below.

Groundwater discharge to Carthage Branch was estimated using the equation for groundwater flux:

$$Q=KiA$$

Where:

Q= groundwater flux to Carthage Branch (gallons per minute or gallons per day)

K= hydraulic conductivity (average 850 ft/yr or 2.3 f/d; from CH2MHill, 1986)

i= gradient of the uppermost aquifer (0.04 unitless)

A=cross-sectional area discharging to Carthage Branch (700' length X 10' depth = 7000 sq ft; see explanation below)

Using the formula and parameters listed above, groundwater flux from the east bank of Carthage Branch is estimated to be 3773 gpd.

The area of groundwater discharge (A) was calculated by assuming a depth of discharge of 10 ft (which is likely an over-estimation as the stream is only a couple of feet deep; this parameter is therefore conservative) and a length of discharge of 700 ft (the length along Carthage Branch perpendicular to the direction of groundwater flow). The length of the discharge zone of groundwater covers the area of former plant operations where groundwater flows to Carthage Branch instead of the Black Warrior River.

Table 5.4: Surface Water Screening Values

Constituent of Concern (COI)	Surface Water Ecological Screening Chronic Values (mg/L)	Drinking Water Standard (mg/L)	Alabama Human Health Criteria for Consumption of	
			Water & Fish (mg/L)	Fish Only (mg/L)
Benzene	0.053 (7)	0.005 (1)	0.011 (3)	0.774 (4)
Toluene	0.175 (7)	1.0 (1)	6.03 (5)	43.6 (6)
Ethylbenzene	0.453 (7)	0.70 (1)	2.24 (5)	6.22 (6)
Xylenes (total)	0.013 (8)	10.0 (1)	NA	NA
Dicyclopentadiene	NA	0.00042 (2)	NA	NA
n-Propylbenzene	NA	0.240 (2)	NA	NA
Styrene	NA	0.10 (1)	NA	NA
1,2,4-Trimethylbenzene	NA	0.0120 (2)	NA	NA
1,3,5-Trimethylbenzene	NA	0.0120 (2)	NA	NA
Naphthalene	0.062 (7)	0.0062 (2)	NA	NA

1= MCL: Safe Drinking Water Act maximum contaminant level
2= PRG: USEPA Region 9 preliminary remediation goal for tap water
3= Alabama Water Quality Criteria, Chapter 335-6-10.07, equation 18
4= Alabama Water Quality Criteria, Chapter 335-6-10.07, equation 19
5= Alabama Water Quality Criteria, Chapter 335-6-10.07, equation 16
6= Alabama Water Quality Criteria, Chapter 335-6-10.07, equation 17
7= EPA Region 4 Waste Management Division Guidance on Ecological Risk Assessments at Military Bases. June, 2000
8= Preliminary Remediation Goals for Ecological Endpoints. U.S.D.O.E. ES/ER/TM-162/R2. 1997
NA=Not Available

Based on an estimated flow in Carthage Branch of 1200 gpm or 1.728 x 10^6 gpd (estimated during sample collection with low flow in late July, 2003), COPCs could be 458 times their risk-based levels in groundwater and still not exceed their risk-based levels in Carthage Branch. Therefore, the concentration of DCPD in the groundwater would need to be 193 ug/L (458 x 0.42 ug/L) to bring the concentration of DCPD to the drinking water standard screening level at the flow rate mentioned. Because DCPD was not detected in all of the groundwater samples collected from the seeps (detection limit = 5 ug/L), and the detection limit is well below the concentration calculated to exceed the screening levels, and the screening level for DCPD is by far the lowest screening level of all of the COPCs, this indicates that there is no potential for the groundwater COPCs to adversely impact ecological or human health in Carthage Branch at this time. The same holds true for the Black Warrior River, which has a much greater assimilative capacity.

5.3: Groundwater Monitoring and Corrective Action Triggers to Protect the Black Warrior River and Carthage Branch

This closure of the wastewater impoundments has to date removed more than 5,600 tons of dewatered sludge and stabilized soils that would have been a potential source of groundwater contamination. Further excavation is impracticable and has the potential to open up a pathway to groundwater. In addition, the proposed closure will remove the impoundments themselves, thereby eliminating the hydraulic down-pressure on the remaining material to the groundwater. The proposed cap will also severely limit intrusion of water through the area of remaining soil contamination, thereby effectively reducing the movement of these constituents into the groundwater. Coverage of the area with clean soils and vegetation will also eliminate contaminates from stormwater runoff in this area, thereby greatly improving the discharge to surface waters.

Eastman is proposing to continue groundwater monitoring at the site to ensure that this exposure pathway of groundwater to surface water is protected. As recommended by the ADEM Closure Guidelines for Industrial Wastewater Impoundments, three down-gradient wells (MW-3, 4, & 5D) and one up-gradient well will be monitored (MW-11). Monitoring wells MW-3 & 4 are screened in the upper aquifer of the terrace/Upper Gordo formation. Monitoring well MW-5D was re-drilled into the Lower Gordo formation due to a lack of water saturation at its original depth in the terrace/Upper Gordo formation. These wells will provide extended vertical coverage of the aquifers below the impoundments. Monitoring well MW-11 is the down-gradient well for the historical contamination from the storage tank, and is also up-gradient from the wastewater impoundments being closed. All of the wells combined will not only monitor the COPCs for the wastewater impoundments, but will continue to track the trend of legacy contamination from the previously identified storage tank source. Therefore the addition of monitoring wells MW-3 & 4 to the ongoing monitoring of wells MW-5D & 11 on a semi-annual schedule, with reporting on an annual basis, is proposed.

While it is unlikely that groundwater concentrations of the COPCs will increase with the removal of potential sources and the implementation of physical and institutional controls, it is proposed that down-gradient wells MW-3 and MW-4 be used as compliance wells for the potential points of exposure in the surface waters of Carthage Branch and the Black Warrior River. The concentrations calculated as the levels of COPCs in groundwater that would not result in exceedance of drinking water standards in Carthage Branch are proposed as Alternative Concentration Limits. The calculation of Alternative Concentration Limits to protect water quality in Carthage Branch is more conservative than similar calculations based upon the Black Warrior River and therefore also protective of the river. Calculations based upon meeting the conservative drinking water standards will also achieve the water quality criteria and ecological screening levels for those constituents with values listed in Table 5.4. While the calculated SGPS values are analogous to ARBCA Tier 1 risk-based screening levels, the approach used for these trigger levels is similar to Tier 2, or site-specific target levels.

For this calculation, the points of exposure are assumed to be Carthage Branch and the Black Warrior River, at the points where groundwater discharges to the surface waters from the site. This assumption is not unreasonable, as drinking water from a municipal water system is available at the site, and dermal contact to buried soils left in place is unlikely. This approach is conservative in that no drinking water intakes are located on Carthage Branch or nearby on the river; in fact, the stream and the Black Warrior River are not classified by ADEM as suitable for drinking water (or water contact sports).

A simple mass-balance equation was used to back-calculate the maximum groundwater concentrations for the COIs in the compliance wells that would not result in exceedances of drinking water standards or human health based water quality standards in Carthage Branch or the Black Warrior River after transport by groundwater to the surface waters. The equation accounts for the discharge of groundwater flows in the streams, but ignores the active removal mechanisms that would reduce the concentration of constituents, such as biodegradation in the stream sediments of the groundwater discharge zone, and volatilization from surface waters, therefore the approach is additionally conservative.

$$C_{TR} = \frac{Q_{GW}\, C_{GW} + Q_{RB}\, C_{RB}}{Q_{TR}}$$

Where:

C_{TR} = Maximum permissible surface water concentration of constituent, based on MCL or Region 9 PRG for drinking water.

Q_{GW} = Groundwater flow to Carthage Branch = 504 cfd or 5.83 x 10^{-3} cfs ($Q=KiA$; K=2.3 f/d; i=0.04; A=10 ft x 700 ft- see section 5.2.1 for detailed explanation)
= Groundwater flow to Black Warrior River[1] = 9900 cfd or 0.115 cfs ($Q=KiA$; K=28 f/d; i=0.04; A=50 ft x 1100 ft- see footnote for detailed explanation)

Q_{RB} = Estimated low flow of Carthage Branch[2] = 2.67 cfs
= 7Q10 of Black Warrior River = 314.19 cfs[3]

[1] The area of groundwater discharge (A) was calculated by assuming a depth of discharge of 50 ft (which is significantly thicker than the Terrace/Upper Gordo Aquifer, and therefore conservative) and a length of discharge of 1100 ft. The length of the discharge zone of contaminated groundwater is assumed to be from the approximate location of MW-8 to the confluence of Carthage Branch and the Black Warrior River. As all of the COPCs are not detected in MW-8, the assumed length of the discharge zone (i.e., width of the groundwater plume) is also conservative.

[2] Estimated during low flow sampling event, July 2003

[3] Source: Marla A. Shelley, ADEM Water Division

C_{RB} = Background concentration of constituent in Carthage Branch and Black Warrior River (set at 0 in order to calculate contribution of groundwater to surface water concentrations).

Q_{TR} = Total Carthage Branch flow $Q_{GW} + Q_{RB}$ = 2.68 cfs
= Total Black Warrior River flow $Q_{GW} + Q_{RB}$ = 314.305 cfs

C_{GW} = Calculated concentration of COPCs in groundwater at the compliance wells that would not result in an exceedance of drinking water standard in surface waters:

Table 5.5 provides the calculations of the COPCs in groundwater at the compliance wells that would not result in an exceedance of the drinking water standard in Carthage Branch and the Black Warrior River. The conservative values calculated are proposed as the triggers for further evaluation of the need for corrective action. If any of the values for the COPCs are exceeded in the compliance wells (MW-3 & 4), Eastman will conduct additional monitoring to evaluate if the COPCs are impacting Carthage Branch or the Black Warrior River and provide this information to ADEM. The additional monitoring will consist of collection and analyses of the COPCs in samples from the seeps along the surface water boundaries, along with surface water samples from the stream potentially impacted.

Table 5.5: Compliance Wells Trigger Levels for Evaluation of Corrective Action

COPCs	Lowest Standard (mg/L)	Compliance Well Trigger Levels for Further Monitoring of Carthage Branch Seeps and Surface Water (mg/L)	Compliance Well Trigger Levels for Further Monitoring of the Black Warrior River Seeps and Surface Water (mg/L)
Benzene	0.005 (1)	2.30	13.67
Toluene	1.0 (1)	460	2,733
Ethylbenzene	0.70 (1)	322	1913
Xylenes (total)	10.0 (1)	4597	27,330
Dicyclopentadiene	0.00042 (2)	0.193	1.15
n-Propylbenzene	0.240 (2)	110	656
Styrene	0.10 (1)	46	273
1,2,4-Trimethylbenzene	0.0120 (2)	5.52	32.80
1,3,5-Trimethylbenzene	0.0120 (2)	5.52	32.80
Naphthalene	0.0062 (2)	2.35	16.95

1= MCL: Safe Drinking Water Act maximum contaminant level
2= PRG: USEPA Region 9 preliminary remediation goal for tap water

5.4: Summary of Post-Closure Monitoring

As previously discussed, potential exposure and risk assessment related to COPCs originating from the former storage tank area have been addressed and well documented. Groundwater monitoring that has been reported to ADEM since 1999 has shown a continuing trend of decreasing concentrations of the COPCs. The capping of the former wastewater impoundment area and institutional controls proposed by this closure plan should further limit any potential risk of exposure to the COPCs. The remaining potential for exposure to the COPCs is the groundwater to surface water pathway. Eastman has demonstrated that the COPCs are currently not present at the boundary of the property adjacent to, or in, Carthage Branch or the Black Warrior River in amounts that would exceed the most conservative of published standards, criteria, or ecological screening values. However, a groundwater monitoring program is being proposed to ensure that the water quality in these surface waters is not adversely affected. The monitoring program is summarized by the bullets below.

- Monitor for the COPCs in wells MW-3, 4, 5D, and 11 on a semi-annual basis with reporting to ADEM on an annual basis if the Table 5.5 trigger levels are not exceeded in the most down-gradient compliance wells MW-3 and 4.
- If the Table 5.5 trigger levels for Carthage Branch are exceeded in MW-3 or MW-4, samples will be collected from Carthage Branch and the groundwater seeps along Carthage Branch (seeps A & B) and analyzed for the COPCs. The additional monitoring will occur within 30 days of receipt of the lab results from the well monitoring. Notification to ADEM of the results from these analyses will be made within 30 days of receipt of the additional monitoring lab data. The additional monitoring of Carthage Branch and the groundwater seeps will continue on the semi-annual schedule until COPC concentrations in the compliance wells are below the trigger levels.
- If the Table 5.5 trigger levels for the Black Warrior River are exceeded in MW-3 or MW-4, additional samples will be collected from the Black Warrior River and the groundwater seeps along the river (seeps E & F) and analyzed for the COPCs. Notification to ADEM and continued monitoring requirements will be the same as for Carthage Branch described above.
- If any of the water quality standards, criteria, or ecological screening levels listed in Table 5.4 are exceeded in Carthage Branch or the Black Warrior River, Eastman will propose further evaluations and/or remediation plans for ADEM approval.
- If the monitoring indicates a trend of decreasing concentrations of COPCs, or continues to indicate no potential to exceed any water quality standards, criteria, or ecological screening values for a period of two years after the closure is completed, Eastman will propose to ADEM a reduction or elimination of the groundwater monitoring program.

REFERENCE
6

Eastman Chemical Company
P. O. Box 511, B-54D
Kingsport, Tennessee 37662-5054
Telephone: 423-229-1863
Fax: 423-229-4864
e-mail: rguinn@eastman.com

EASTMAN

CERTIFIED MAIL

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JUL 14 2006
LAND DIVISION

July 10, 2006

Mr. Emmett Hampton
Alabama Department of Environmental Management
Site Assessment Unit, Land Division
P.O. Box 301463
Montgomery, AL 36130-1463

Re: Termination of Groundwater Monitoring & Final Report
Former Eastman Resins Site (fka Lawter International)
Moundville, AL

Dear Mr. Hampton,

In a submittal to you dated January 16, 2006 Eastman Chemical Company (Eastman) reported the results of 2005 groundwater monitoring for the former Eastman Resins, Inc. manufacturing facility located in Moundville, Alabama (fka Lawter International). In that submittal was a letter requesting termination of groundwater monitoring activities at the site based upon the conditions contained within the Closure Plan approved by ADEM for the former wastewater treatment impoundments. Those conditions established compliance monitoring wells down gradient of the former wastewater impoundments, and the historical release site on the interior of the property, and allowed for a request to be submitted to ADEM to terminate monitoring if the results indicated a trend of decreasing concentrations of COPCs and no potential to exceed any water quality standards, criteria, or ecological screening values for a period of two years after the closure was completed. Those conditions were met at the end of 2005 and Eastman formally requested termination of the monitoring program in the January submission but did not receive a response from you in regards to that request. Eastman continued to monitor the groundwater during the first half of 2006 and is providing you with the results of the most recent semi-annual monitoring that occurred in June 2006.

The most recent groundwater monitoring conducted by TTL, Inc. (report attached) continues to show non-detect levels for all COPCs at the two down gradient compliance wells (MW-3 and MW-4) with the exception of one low level detection (8 ug/L) of dicyclopentadiene in MW-4. MW-3 has been consistently at non-detect for all COPCs since 2003, and MW-4 has been at or around non-detect for all COPCs since mid 2004. The COPCs that have been detected in the compliance wells exhibited concentrations that are orders of magnitude below the compliance limits established in the closure plan, and all of the down gradient wells have shown dramatic improvements over the higher concentrations that appeared during the excavation of the wastewater impoundments in 2003. Trend graphs of the COPCs concentrations for the down-gradient wells from the period of the wastewater impoundment excavation through the end of 2005 were provided to you in the January 2006 submittal.

The up gradient well (MW-11) closest to the site of the historic release that occurred prior to Eastman's ownership of the property continues to show significant, consistent improvements due to natural attenuation. Historical and recent COPCs concentrations for this well continue to show trends of decreasing concentrations for all constituents. Based upon existing data, the COPCs remaining in up gradient well MW-11 are not migrating toward the down gradient compliance wells, where historical potentiometric flow direction data indicates they should be detected if present. With no significant concentrations appearing in the down gradient wells over a period of historical groundwater monitoring data of greater than twenty years, it is apparent that the remaining contamination is confined within the property boundaries and continues to demonstrate a consistent downward concentration of COPCs due to natural attenuation. The removal of the wastewater impoundments and installation of an impermeable cap of that area has also improved the situation by decreasing the flow to groundwater of any potential sources of COPCs. This can be seen from the continual improvement of data from well MW-5D. Based on this compelling data, and a lack of objection from ADEM to Eastman's request to terminate groundwater monitoring at this site, this letter serves as Eastman's notice of its intent to terminate the groundwater monitoring program as authorized by the closure plan, and serves as our final groundwater monitoring report.

We appreciate ADEM's cooperation and assistance with the closure of this site. If you have any questions or concerns, please feel free to contact me.

Richard J. Guinn, Ph.D.
Technical Associate

cc: Mr. Wayne Holt, Water Division, Industrial Section

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Decatur . Florence . Montgomery . Tuscaloosa ALABAMA
Albany . Valdosta GEORGIA

June 16, 2006

Mr. Richard Guinn
Eastman Chemical Company
P. O. Box 511, Bld. 54D
Kingsport, TN 37662

Re: Groundwater Sampling
Moundville Plant Site

Dear Mr. Guinn:

Attached is one copy of the results of the June 7, 2006 sampling of groundwater from four monitoring wells at the Moundville site. TTL sampled the wells requested to be sampled for this event by Eastman Chemical. A copy of ADEM's Groundwater Monitoring Report Form for the four sampled wells are attached.

This sampling event was originally performed on May 3, 2006; however, the groundwater samples were not analyzed within the holding time required by EPA Method 8260 as outlined in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," EPA, SW-846. The samples taken in May were therefore not analyzed and the wells were re-sampled on June 7, 2006 and the appropriate analyses conducted. The field data sheets from the May event are included in this report, in the event you wish to review the field data for your information.

This is the final sampling event unless we are notified otherwise that sampling must continue. Should you have any questions, please do not hesitate to call (205) 345-0816. It has been a pleasure to provide you these services.

Sincerely,

TTL, Inc.

Laura Whitaker

Laura Whitaker, P. G.

LW
enclosures

F:\Secretary\2000\0600\058\Lawter GWM results 0606 ltr.wpd

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Date: 12-Jun-06

CLIENT: Lawter International, Inc **Lab Order:** 060607043
Project: Moundville Monitoring Wells - 0600-058

Lab ID: 060607043-001 **Collection Date:** 06/07/2006 9:30
Client Sample ID: MW-3 **Matrix:** Aqueous

Analyses	Result	Limit	Units	DF	Date Analyzed
VOLATILES BY GC/MS		**SW8260B**	Prep:		Analyst: VJB
1,2,4-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
1,3,5-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
Benzene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
Dicyclopentadiene	< 0.005	0.005	mg/L	1	06/08/2006 12:04
Ethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
m,p-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
Naphthalene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
n-Propylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
o-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
Styrene	< 0.005	0.005	mg/L	1	06/08/2006 11:46
Toluene	< 0.005	0.005	mg/L	1	06/08/2006 11:46

Lab ID: 060607043-002 **Collection Date:** 06/07/2006 10:20
Client Sample ID: MW-4 **Matrix:** Aqueous

Analyses	Result	Limit	Units	DF	Date Analyzed
VOLATILES BY GC/MS		**SW8260B**	Prep:		Analyst: VJB
1,2,4-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
1,3,5-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
Benzene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
Dicyclopentadiene	0.008	0.005	mg/L	1	06/08/2006 12:57
Ethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
m,p-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
Naphthalene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
n-Propylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
o-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
Styrene	< 0.005	0.005	mg/L	1	06/08/2006 12:19
Toluene	< 0.005	0.005	mg/L	1	06/08/2006 12:19

Steve C. Martin, Chemist

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Date: 12-Jun-06

CLIENT: Lawter International, Inc **Lab Order:** 060607043
Project: Moundville Monitoring Wells - 0600-058

Lab ID: 060607043-003 **Collection Date:** 06/07/2006 11:30
Client Sample ID: MW-5D **Matrix:** Aqueous

Analyses	Result	Limit	Units	DF	Date Analyzed
VOLATILES BY GC/MS		**SW8260B**	Prep:		Analyst: VJB
1,2,4-Trimethylbenzene	0.015	0.005	mg/L	1	06/08/2006 12:53
1,3,5-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:53
Benzene	0.005	0.005	mg/L	1	06/08/2006 12:53
Dicyclopentadiene	< 0.005	0.005	mg/L	1	06/08/2006 13:54
Ethylbenzene	0.010	0.005	mg/L	1	06/08/2006 12:53
m,p-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 12:53
Naphthalene	0.032	0.005	mg/L	1	06/08/2006 12:53
n-Propylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 12:53
o-Xylene	0.011	0.005	mg/L	1	06/08/2006 12:53
Styrene	< 0.005	0.005	mg/L	1	06/08/2006 12:53
Toluene	< 0.005	0.005	mg/L	1	06/08/2006 12:53

Lab ID: 060607043-004 **Collection Date:** 06/07/2006 12:20
Client Sample ID: MW-11 **Matrix:** Aqueous

Analyses	Result	Limit	Units	DF	Date Analyzed
VOLATILES BY GC/MS		**SW8260B**	Prep:		Analyst: VJB
1,2,4-Trimethylbenzene	1.73	0.050	mg/L	10	06/09/2006 12:04
1,3,5-Trimethylbenzene	0.663	0.025	mg/L	5	06/08/2006 16:37
Benzene	< 0.025	0.025	mg/L	5	06/08/2006 16:37
Dicyclopentadiene	0.193	0.005	mg/L	1	06/08/2006 15:07
Ethylbenzene	0.244	0.025	mg/L	5	06/08/2006 16:37
m,p-Xylene	0.875	0.025	mg/L	5	06/08/2006 16:37
Naphthalene	1.19	0.050	mg/L	10	06/09/2006 12:04
n-Propylbenzene	0.141	0.025	mg/L	5	06/08/2006 16:37
o-Xylene	1.22	0.050	mg/L	10	06/09/2006 12:04
Styrene	0.232	0.025	mg/L	5	06/08/2006 16:37
Toluene	0.040	0.025	mg/L	5	06/08/2006 16:37

Steve C. Martin, Chemist

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Date: 12-Jun-06

CLIENT: Lawter International, Inc **Lab Order:** 060607043
Project: Moundville Monitoring Wells - 0600-058

Lab ID: 060607043-005 **Collection Date:** 06/07/2006 0:00
Client Sample ID: Trip Blank **Matrix:** Aqueous

Analyses	Result	Limit	Units	DF	Date Analyzed
VOLATILES BY GC/MS		**SW8260B**	Prep:		Analyst: VJB
1,2,4-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
1,3,5-Trimethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
Benzene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
Dicyclopentadiene	< 0.005	0.005	mg/L	1	06/08/2006 16:35
Ethylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
m,p-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
Naphthalene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
n-Propylbenzene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
o-Xylene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
Styrene	< 0.005	0.005	mg/L	1	06/08/2006 17:11
Toluene	< 0.005	0.005	mg/L	1	06/08/2006 17:11

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Date: 12-Jun-06

CLIENT:	Lawter International, Inc
Project:	Moundville Monitoring Wells - 0600-058
Lab Order:	060607043

CASE NARRATIVE

The samples were analyzed in accordance with Method 8260 outlined in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", EPA, SW-846.

TTL WORK
ORDER NUMBER
060607 043

NJS

Chain of Custody Form

Sheet 1 of 1

Client: TTL (Lawter International)
Contact: Laura Whitaker
Mailing Address:
City, State, Zip:
Phone No.:
Date: 6-7-06
Sampled By: Z. Peak, J. Peak
Sample Site: Lawter Int., Moundville, Al
TTL Job No.: 0600-058 Client P.O. #

Sample Security Requirements

1. Condition of Contents: good
2. Sealed for Shipping By:
3. Initial Contents Temp.: Ice °C Seal Applied Yes ____ No ____
4. Sampling Status: Complete Expected Completion Date
5. Custody Seal Intact Upon Receipt by Laboratory: Yes ____ No ____
6. Condition of Contents: Good
7. Comments: +oe
8. Reporting Status: Routine; ASAP By ____; Rush By ____

6-21-06

Date	Time	Sample ID/Description	Sample Type (Solid, Etc.)	Sample Method: Grab	Sample Method: Comp	# of Containers	Preservatives	Analysis Parameters
6-7	9:30	MW-3	H2O	x		4	HCl	8260 plus dicyclopentadiene
↓	10:20	4	↓	↓		↓	↓	↓
↓	11:30	5D	↓	↓		↓	↓	↓
↓	12:20	11	↓	↓		↓	↓	↓
↓		Trip Blank	↓	↓		↓	↓	↓

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed) Date/Time
1 Ezekiel Peak 6-7-06 2:35 PM
2
3

Received by (signed) Date/Time
1
2
3

SHIPPING DETAILS

Air Bill #:
Method of Shipment: Hand
Received By Lab: [signature] Dixon
Date/Time 6-7-06 2:35 PM

TTL, Inc. - Tuscaloosa Office/Laboratory: 3516 Greensboro Avenue, Tuscaloosa, Alabama 35401, Telephone (205) 345-0816, FAX (205) 345-0992
TTL, Inc. - Montgomery Office: 4154 Lomac Street, Montgomery, Alabama 36106, Telephone (334) 244-0766, FAX (334) 244-6668
TTL, Inc. - Florence Office: 523 South Wood Avenue, Florence, Alabama 35630, Telephone (256) 766-4622, FAX (256) 760-4626
TTL, Inc. - Decatur Office: 310 Bank Street, Decatur, Alabama 35601, Telephone (256) 353-2910, FAX (256) 353-3944

NOTE:

LABORATORY	TTL, Inc.		FACILITY NAME:	Lawter International
ADDRESS	3516 Greensboro Ave.			
	Tuscaloosa, AL 35401		PERMIT NUMBER:	
LAB TELEPHONE	(205) 345-0816			

ADEM-GROUNDWATER MONITORING REPORT

SAMPLING DATE: 06/07/06 TIME: 9:30 a.m. PERSON COLLECTING SAMPLE: Z. Peak

WELL NUMBER: MW-3 TOP OF CASING ELEVATION (MSL): ______

TOTAL DEPTH OF WELL: 53.9 ft BLS DEPTH TO WATER: 37.15 ft BMP

VOL REMOVED BEFORE SAMPLING: 8.5 gal

INSIDE DIAMETER OF WELL CASING: 2 in. WELL CASING MATERIAL: PVC

SAMPLING EQUIPMENT: (BAILER, PUMP, ETC.): Disposable Bailer

PRESERVATIVES USED: Below SAMPLE CONTAINER: TYPE: Below (glass, plastic) SIZE: Below (qt., gal., etc.)

Comments: (To include weather conditions, condition of well, color of sample, odor, unusual characteristics, accessibility, etc.) Report due for dry wells also.

Record Below

Preservatives and sample containers:
(Indicate the number of each type used)

—	quart, plastic, no preservative
—	quart, plastic, with H_2SO_4
—	quart, plastic, with HNO_3 (unfiltered sample)
—	quart, plastic, with HNO_3 (sample field filtered)
4	VOC vials

Comments

Specific conductance	134	(µmhos/cm)
pH	4.96	(standard units)
Temperature	18.33 °C	(degrees in F or C)
Color of sample	Turbidity= 28 NTU	
Odor of sample	None	
Unusual characteristics	None	
Filter size, if filtered	N/A	
Weather conditions	Sunny, 89°F	
Accessibility of well	Good	
Condition of well	Good	
Other comments		

MAIL ALL REPORTS TO:

Phil Davis, Chief
Ind/Haz Waste Branch
ADEM
P. O. Box 301463
Montgomery, AL 36130-1463

I CERTIFY THAT ALL RESULTS ARE TRUE AND ACCURATE AND PERFORMED IN ACCORDANCE WITH PROCEDURES APPROVED BY EPA AND/OR ADEM.

Laura Whitaker
(signature of responsible person)

Number of Pages to follow: 3

ADEM Form 270 03/94

(Sections for containers, preservatives, comments, expanded with ADEM's permission)

LABORATORY ADDRESS: TTL, Inc.
3516 Greensboro Ave.
Tuscaloosa, AL 35401

LAB TELEPHONE: (205) 345-0816

FACILITY NAME: Lawter International

PERMIT NUMBER:

ADEM-GROUNDWATER MONITORING REPORT

SAMPLING DATE: 06/07/06 TIME: 10:20 a.m. PERSON COLLECTING SAMPLE: Z. Peak

WELL NUMBER: MW-4 TOP OF CASING ELEVATION (MSL):

TOTAL DEPTH OF WELL: 52.5 ft BLS DEPTH TO WATER: 43.67 ft BMP

VOL REMOVED BEFORE SAMPLING: 5 gal

INSIDE DIAMETER OF WELL CASING: 2 in. WELL CASING MATERIAL: PVC

SAMPLING EQUIPMENT: (BAILER, PUMP, ETC.): Disposable Bailer

PRESERVATIVES USED: Below SAMPLE CONTAINER: TYPE: Below (glass, plastic) SIZE: Below (qt., gal., etc.)

Comments: (To include weather conditions, condition of well, color of sample, odor, unusual characteristics, accessibility, etc.) Report due for dry wells also.

Record Below

Preservatives and sample containers:
(Indicate the number of each type used)

—	quart, plastic, no preservative
—	quart, plastic, with H_2SO_4
—	quart, plastic, with HNO_3 (unfiltered sample)
—	quart, plastic, with HNO_3 (sample field filtered)
4	VOC vials

Comments

Specific conductance	128	(μmhos/cm)
pH	5.56	(standard units)
Temperature	19.71 °C	(degrees in F or C)
Color of sample	Turbidity= 468 NTU	
Odor of sample	None	
Unusual characteristics	None	
Filter size, if filtered	N/A	
Weather conditions	Sunny, 89°F	
Accessibility of well	Good	
Condition of well	Good	
Other comments		

MAIL ALL REPORTS TO:

Phil Davis, Chief
Ind/Haz Waste Branch
ADEM
P. O. Box 301463
Montgomery, AL 36130-1463

I CERTIFY THAT ALL RESULTS ARE TRUE AND ACCURATE AND PERFORMED IN ACCORDANCE WITH PROCEDURES APPROVED BY EPA AND/OR ADEM.

Laura Whitaker
(signature of responsible person)

Number of Pages to follow: 2

ADEM Form 270 03/94

(Sections for containers, preservatives, comments, expanded with ADEM's permission)

LABORATORY ADDRESS	TTL, Inc. 3516 Greensboro Ave. Tuscaloosa, AL 35401	FACILITY NAME:	Lawter International
		PERMIT NUMBER:	
LAB TELEPHONE	(205) 345-0816		

ADEM-GROUNDWATER MONITORING REPORT

SAMPLING DATE: 06/07/06 TIME: 11:30 a.m. PERSON COLLECTING SAMPLE: J. Peak

WELL NUMBER: MW-5D TOP OF CASING ELEVATION (MSL): ______

TOTAL DEPTH OF WELL: 85.2 ft BLS DEPTH TO WATER: 51.75 ft BMP

VOL REMOVED BEFORE SAMPLING: 17 gal

INSIDE DIAMETER OF WELL CASING: 2 in. WELL CASING MATERIAL: PVC

SAMPLING EQUIPMENT: (BAILER, PUMP, ETC.): Disposable Bailer

PRESERVATIVES USED: Below SAMPLE CONTAINER: TYPE: Below (glass, plastic) SIZE: Below (qt., gal., etc.)

Comments: (To include weather conditions, condition of well, color of sample, odor, unusual characteristics, accessibility, etc.) Report due for dry wells also.

Record Below

Preservatives and sample containers:
(Indicate the number of each type used)

—	quart, plastic, no preservative
—	quart, plastic, with H_2SO_4
—	quart, plastic, with HNO_3 (unfiltered sample)
—	quart, plastic, with HNO_3 (sample field filtered)
4	VOC vials

Comments

Specific conductance	116	(µmhos/cm)
pH	6.14	(standard units)
Temperature	20.65 °C	(degrees in F or C)
Color of sample	Turbidity = 348 NTU	
Odor of sample	Slight indistinguishable odor	
Unusual characteristics	None	
Filter size, if filtered	N/A	
Weather conditions	Sunny, 89°F	
Accessibility of well	Good	
Condition of well	Good	
Other comments		

MAIL ALL REPORTS TO:

Phil Davis, Chief
Ind/Haz Waste Branch
ADEM
P. O. Box 301463
Montgomery, AL 36130-1463

I CERTIFY THAT ALL RESULTS ARE TRUE AND ACCURATE AND PERFORMED IN ACCORDANCE WITH PROCEDURES APPROVED BY EPA AND/OR ADEM.

Laura Whitaker
(signature of responsible person)

Number of Pages to follow: 1

ADEM Form 270 03/94

(Sections for containers, preservatives, comments, expanded with ADEM's permission)

LABORATORY ADDRESS: TTL, Inc.
3516 Greensboro Ave.
Tuscaloosa, AL 35401

LAB TELEPHONE: (205) 345-0816

FACILITY NAME: Lawter International

PERMIT NUMBER:

ADEM-GROUNDWATER MONITORING REPORT

SAMPLING DATE: 06/07/06 TIME: 12:20 p.m.

PERSON COLLECTING SAMPLE: J. Peak

WELL NUMBER: MW-11

TOP OF CASING ELEVATION (MSL):

TOTAL DEPTH OF WELL: 40.2 ft BLS

DEPTH TO WATER: 26.82 ft BMP

VOL REMOVED BEFORE SAMPLING: 7.4 gal

INSIDE DIAMETER OF WELL CASING: 2 in.

WELL CASING MATERIAL: PVC

SAMPLING EQUIPMENT: (BAILER, PUMP, ETC.): Disposable Bailer

PRESERVATIVES USED: Below SAMPLE CONTAINER: TYPE: Below (glass, plastic) SIZE: Below (qt., gal., etc.)

Comments: (To include weather conditions, condition of well, color of sample, odor, unusual characteristics, accessibility, etc.) Report due for dry wells also.

Record Below

Preservatives and sample containers:
(Indicate the number of each type used)

—	quart, plastic, no preservative
—	quart, plastic, with H_2SO_4
—	quart, plastic, with HNO_3 (unfiltered sample)
—	quart, plastic, with HNO_3 (sample field filtered)
4	VOC vials

Comments

Specific conductance	225	(μmhos/cm)
pH	5.44	(standard units)
Temperature	19.66 °C	(degrees in F or C)
Color of sample	Turbidity = 127 NTU	
Odor of sample	Strong indistinguishable odor	
Unusual characteristics	None	
Filter size, if filtered	N/A	
Weather conditions	Sunny, 89°F	
Accessibility of well	Good	
Condition of well	Poor (broken casing, bent stand up cover)	
Other comments		

MAIL ALL REPORTS TO:

Phil Davis, Chief
Ind/Haz Waste Branch
ADEM
P. O. Box 301463
Montgomery, AL 36130-1463

I CERTIFY THAT ALL RESULTS ARE TRUE AND ACCURATE AND PERFORMED IN ACCORDANCE WITH PROCEDURES APPROVED BY EPA AND/OR ADEM.

Laura Whitaker

(signature of responsible person)

Number of Pages to follow: 0

ADEM Form 270 03/94

(Sections for containers, preservatives, comments, expanded with ADEM's permission)

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International
TTL Project No.: 0600.058
Sample Date: 6-7-06 Time: 9:30
Person Collecting Sample: Z. Peak
Purge Date: 6-7-06 Well Number: MW-3
Top of Casing Elevation (MSL):
Diameter of Well Casing: 2 inches
Well Casing Material: PVC
Total Depth of Well (TD): 53.9 feet
Depth of Water (DW): 37.15
One Well Volume: 2.8 gal X3 8.5 gal X5 gal
Purging Equipment: Dedicated Bailer
Sampling Equipment: Dedicated Bailer
Field Parameter Equipment (brand & SN): YSI 04A1060

Time	9:04	9:06	9:11	9:15	9:20							
Volume (gal.)	1	2	4	6	8							
Water Level (ft.)												
Temperature (°C)	18.53	1831	18.32	18.23	18.33							
Sp. Cond. (μmhos)	129	130	130	129	134							
pH	6.73	5.28	4.63	4.70	4.96							
D.O.	8.80	8.10	7.72	8.27	8.95							
ORP	307.8	328.3	335.5	324.2	305.9							
Turbidity (NTU)	89	653	567	383	115							
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 8.5 gal
Color of Sample: 28 NTU
Odor of Sample: N/A
Weather Conditions: Sunny 89°F
Accessibility of Well: good
Condition of Well: good
Unusual Characteristics:
Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International
TTL Project No.: 0600-058
Sample Date: 6-7-06
Time: 10:20
Person Collecting Sample: Z. Peak
Purge Date: 6-7-06
Well Number: MW-4
Top of Casing Elevation (MSL):
Diameter of Well Casing: 2" inches
Well Casing Material: PVC
Total Depth of Well (TD): 52.5 feet
Depth of Water (DW): 43.67
One Well Volume: 1.5 gal
X3 4.5 gal
X5 gal
Purging Equipment: Dedicated Bailer
Sampling Equipment: Dedicated Bailer
Field Parameter Equipment (brand & SN): YSI 04A1060

Time	10:04	10:06	10:08	10:10	10:12								
Volume (gal.)	1	2	3	4	5								
Water Level (ft.)													
Temperature (°C)	20.08	19.92	19.79	19.76	19.71								
Sp. Cond. (µmhos)	197	166	143	132	128								
pH	5.95	5.71	5.65	5.58	5.56								
D.O.	7.21	5.72	4.49	4.14	3.99								
ORP	256.7	260.6	256.4	258.7	256.7								
Turbidity (NTU)	400	557	594	769	647								
Pump Setting													
Carbon Dioxide													
Iron II													
Alkalinity													
Sulfide													

Total Volume Purged: 5.4 gal
Color of Sample: 468 ntu
Odor of Sample: None
Weather Conditions: Sunny 89°F
Accessibility of Well: good
Condition of Well: good
Unusual Characteristics:
Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International

TTL Project No.: 0600-058

Sample Date: 6-7-06 Time: 11:30 Person Collecting Sample: J. Peak

Purge Date: 6-7-06 Well Number: MW-5D Top of Casing Elevation (MSL):

Diameter of Well Casing: 2" Inches Well Casing Material: PVC

Total Depth of Well (TD): 85.2 feet Depth of Water (DW): 51.75

One Well Volume: 5.6 gal X3 17 gal X5 gal

Purging Equipment: Dedicated Bailer Sampling Equipment: Dedicated Bailer

Field Parameter Equipment (brand & SN): D4A1060

Time	10:51	10:55	10:59	11:04	11:10	11:17	11:21					
Volume (gal.)	1	3	6	9	12	15	17					
Water Level (ft.)	~~21.27~~											
Temperature (°C)	21.27	21.11	21.27	21.01	20.83	20.85	20.65					
Sp. Cond. (µmhos)	133	127	143	137	126	112	116					
pH	6.37	6.20	6.30	6.22	6.29	6.20	6.14					
D.O.	6.72	5.21	4.78	3.97	3.81	3.71	4.10					
ORP	195.7	160.3	143.5	132.9	121.1	123.4	124.1					
Turbidity (NTU)	468	90	92	168	196	255	407					
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 17 gal Color of Sample: 348 NTU Odor of Sample: Slight (UNDIS.)

Weather Conditions: Sunny 89°F

Accessibility of Well: good Condition of Well: good

Unusual Characteristics:

Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International

TTL Project No.: 0600-058

Sample Date: 6-7-06

Time: 12:20

Person Collecting Sample: J. Peak

Purge Date: 6-7-06

Well Number: MW-11

Top of Casing Elevation (MSL):

Diameter of Well Casing: 2" inches

Well Casing Material: PVC

Total Depth of Well (TD): 40.2 feet

Depth of Water (DW): 26.82

One Well Volume: 2.2 gal

X3 6.8 gal

X5 ____ gal

Purging Equipment: Dedicated bailer

Sampling Equipment: Dedicated Bailer

Field Parameter Equipment (brand & SN): YSI 04A1060

Time	11:52	11:54	11:58	12:03	12:05							
Volume (gal.)	1	2	4	6	7 Dry							
Water Level (ft.)												
Temperature (°C)	23.08	21.57	20.32	20.04	19.66							
Sp. Cond. (μmhos)	224	232	228	223	225							
pH	6.21	5.55	5.53	5.52	5.44							
D.O.	7.47	3.81	4.10	4.38	5.17							
ORP	188.9	192.6	191.4	188.6	191.6							
Turbidity (NTU)	69	116	104	>1000	>1000							
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 7.4 gal

Color of Sample: 127 ntu

Odor of Sample: Strong odor

Weather Conditions: Sunny 89° F

Accessibility of Well: good

Condition of Well: poor

Unusual Characteristics:

Other Comments:

F:\Secretary\MISC\FORMS\GWM Rpt J Mills.xls

TTL

geotechnical • analytical • materials • environmental

3516 Greensboro Avenue (35401)
Drawer 1128
Tuscaloosa, Alabama 35403
Telephone 205.345.0816
Facsimile 205.345.0992
www.TTLINC.com

Decatur . Florence . Montgomery . Tuscaloosa ALABAMA
Albany . Valdosta GEORGIA

Client: Lawter International

Date: 6-7-06

Instrument or Serial No.	Parameter	Initial Reading	Calibration Standard Reading	Buffer Reading	Tap Water Reading	Tap Water Reading	Tap Water Reading
04A1060	Cond	1387	1413	1413	172		
	PH	7.00	7.00	7.00	8.27		
	PH	4.02	4.00	4.00			
	Redox	204.6	240	240.0	166.5		
	Temp				22.65		
	DO				8.67		

Calibration:

Maintenance:

Remarks:

Ezekiel Peak
Field Technician

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International | TTL Project No.: 0600-058

Sample Date: 5-3-06 | Time: 9:14 | Person Collecting Sample: Z. Peek

Purge Date: 5-3-06 | Well Number: MW-3 | Top of Casing Elevation (MSL):

Diameter of Well Casing: 2" inches | Well Casing Material: PVC

Total Depth of Well (TD): 53.9 feet | Depth of Water (DW): 36.91

One Well Volume: 2.8 gal | X3 8.6 gal | X5 gal

Purging Equipment: Bailer | Sampling Equipment: Bailer

Field Parameter Equipment (brand & SN): YSI 04A1060

Time	8:51	8:53	8:55	8:57	9:00	9:04						
Volume (gal.)	0.3	1	2	4	6	8						
Water Level (ft.)												
Temperature (°C)	18.45	18.09	18.03	18.01	17.98	17.99						
Sp. Cond. (μmhos)	133	132	133	132	132	133						
pH	6.02	5.22	4.96	4.64	4.69	4.81						
D.O.	8.54	6.96	6.83	6.54	7.08	8.22						
ORP	343.1	349.1	349.4	358.1	349.2	335.1						
Turbidity (NTU)	6.2	17.7	273	299	311	95.7						
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 9 gal | Color of Sample: 17.1 Ntu | Odor of Sample: None

Weather Conditions: Cloudy 85°

Accessibility of Well: good | Condition of Well: good

Unusual Characteristics:

Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter INterNational   TTL Project No.: 0600-058
Sample Date: 5-3-06   Time: 9156   Person Collecting Sample: ZAJ Pea
Purge Date: 5-3-06   Well Number: MW-4   Top of Casing Elevation (MSL):
Diameter of Well Casing: 2" inches   Well Casing Material: PVC
Total Depth of Well (TD): 52.5 feet   Depth of Water (DW): 43.64
One Well Volume: 1.5 gal   X3 4.5 gal   X5 gal
Purging Equipment: D. Bailer   Sampling Equipment: D. Bailer
Field Parameter Equipment (brand & SN): YSI 04A1060

Time	9137	9:39	9:40	9142	9:44	9:46						
Volume (gal.)	0.3	1	2	3	4	5						
Water Level (ft.)												
Temperature (°C)	19.71	19.70	19.70	19.69	19.69	19.69						
Sp. Cond. (µmhos)	194	175	151	134	127	121						
pH	5.49	5.37	5.39	5.49	5.43	5.47						
D.O.	7.69	6.36	4.57	3.96	3.89	3.60						
ORP	289.5	291.6	285.4	277.4	276.2	269.5						
Turbidity (NTU)	44.4	Λ444	Λ444	Λ444	Λ444	Λ444						
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 5.3 gal   Color of Sample: NTU 384   Odor of Sample: N/A
Weather Conditions: Cloudy 85°F
Accessibility of Well: Fair   Condition of Well: Good
Unusual Characteristics:
Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International

TTL Project No.: 0600-058

Sample Date: 5-3-06

Time: 11:05

Person Collecting Sample: Z. Peale

Purge Date: 5-3-06

Well Number: MW-5D

Top of Casing Elevation (MSL):

Diameter of Well Casing: 2" inches

Well Casing Material:

Total Depth of Well (TD): 85.2 feet

Depth of Water (DW): 51.57

One Well Volume: 5.7 gal X3 17.1 gal X5 gal

Purging Equipment: Bailer

Sampling Equipment: Bailer

Field Parameter Equipment (brand & SN): YSI 04A1060

Time	10:30	10:33	10:37	10:43	10:48	10:53						
Volume (gal.)	0.3	2	4	8	12	16						
Water Level (ft.)												
Temperature (°C)	20.19	20.12	20.01	20.35	20.44	20.36						
Sp. Cond. (μmhos)	93	92	102	188	178	147						
pH	6.30	5.94	5.99	6.14	6.31	6.27						
D.O.	6.23	5.36	4.75	4.20	3.93	3.75						
ORP	172.8	182.5	173.5	148.3	62.6	44.7						
Turbidity (NTU)	85.2	27.3	30.5	44.6	74.2	99.5						
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 17 gal

Color of Sample: 71.1

Odor of Sample: Slight odor (Chem)?

Weather Conditions: cloudy 85°

Accessibility of Well: good

Condition of Well: good

Unusual Characteristics:

Other Comments:

GROUNDWATER MONITORING REPORT

Facility Name: Lawter International TTL Project No.: 0600-058

Sample Date: 5-3-06 Time: 12:13 Person Collecting Sample: Z+J Read

Purge Date: 5-3-06 Well Number: MW-11 Top of Casing Elevation (MSL):

Diameter of Well Casing: 2" inches Well Casing Material: PVC

Total Depth of Well (TD): 40.2 feet Depth of Water (DW): 26.57

One Well Volume: 2.3 gal X3 6.9 gal X5 gal

Purging Equipment: D. Bailer Sampling Equipment: D. Bailer

Field Parameter Equipment (brand & SN): YSI 04A1060

Time	11:50	11:52	11:53	11:55	11:58	12:03						
Volume (gal.)	0.3	1	2	3	5	7						
Water Level (ft.)												
Temperature (°C)	20.69	20.11	19.63	19.37	19.27	19.34						
Sp. Cond. (µmhos)	235	229	227	229	228	227						
pH	5.80	5.50	5.53	5.30	5.36	5.33						
D.O.	4.95	4.21	3.82	3.76	3.98	3.86						
ORP	156.4	165.2	168.4	165.8	157.8	156.9						
Turbidity (NTU)	21.1	56.7	72.6	64.4	66.5	306						
Pump Setting												
Carbon Dioxide												
Iron II												
Alkalinity												
Sulfide												

Total Volume Purged: 7.3 gal Color of Sample: NTU 296 Odor of Sample: Strong (Chem.)

Weather Conditions: Cloudy 85°F

Accessibility of Well: OK Condition of Well: Fair

Unusual Characteristics:

Other Comments:

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3516 Greensboro Avenue (35401)
Drawer 1128
Tuscaloosa, Alabama 35403
Telephone 205.345.0816
Facsimile 205.345.0992
www.TTLINC.com

Decatur . Florence . Montgomery . Tuscaloosa ALABAMA
Albany . Valdosta GEORGIA

Client: Lawter International

Date: 5-3-06

Instrument or Serial No.	Parameter	Initial Reading	Calibration Standard Reading	Buffer Reading	Tap Water Reading	Tap Water Reading	Tap Water Reading
04A1060	Cond	1459	1413	1413	142		
	PH	7.07	7.00	7.00	7.96		
	PH	4.02	4.00	4.00			
	Redox	194.5	240	240	170.8		
	Temp				21.83		
	Do				9.24		

Calibration:

Maintenance:

Remarks:

Ezekiel Peal
Field Technician

REFERENCE
7

ONIS "TREY" GLENN, III
D~~CTOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2059 • Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700
FAX (334) 271-7950

BOB RILEY
GOVERNOR

February 29, 2008

Mr. Richard Campo
Alabama Biodiesel Corporation
12982 Cherokee Bend Road
Moundville, Alabama 35474

Re: Termination of groundwater monitoring activities

Dear Mr. Campo:

Base on the information submitted by Eastman Chemicals, Inc., the Department concurs with the request to cease groundwater monitoring activities. In the event of a new release or additional data that indicates elevated levels of constituents of concern, additional sampling may be necessary.

The Department understands that the Alabama Biodiesel Corporation intends to reenroll this site in the Brownfield Redevelopment and Voluntary Cleanup Program. Please contact Larry Norris, Chief of the Redevelopment Section at (334)279-3053 or by email at lan@adem.state.al.us for assistance with the application process.

Sincerely,

James L. Bryant

James L. Bryant, PE
Chief, Environmental Services Branch

JLB/ln

REFERENCE
8

Alabama Department of Environmental Management	Water Division	Drinking Water Branch
County Map of AL	Water System Search	Help

Water System Facilities	Violations Enforcement Actions	TCR Sample Results	TTHM HAA5 Summaries
Sample Points	Assistance Actions	Recent Positive TCR Results	PBCU Summaries
Sample Schedules / FANLs / Plans	Compliance Schedules	Other Chemical Results	Chlorine Summaries
Site Visits Milestones	TOC/Alkalinity Results	Chemical Results by: Name Code	Turbidity Summaries
Operators All POC	LRAA (TTHM/HAA5)	Recent Non-TCR Sample Results	TCR Sample Summaries

Water System Detail Information

Water System No.:	AL0000651	Federal Type:	C
Water System Name:	MOUNDVILLE WATER WORKS	Federal Source:	GW
Principal County Served:	HALE	System Status:	A
Principal City Served:	MOUNDVILLE	Activity Date:	06-01-1975

Water System Contacts

Type	Contact	Communication	
		Phone Type	Value
AC - Administrative Contact	WYATT, JOSHAUA P.O. Box 98 MOUNDVILLE, AL 35474	BUS - Business	205-371-2641
DO - Designated Operator	SMITHERMAN, AUBREY P O BOX 485 MARION, AL 36756		

List of Operators   Complete Point of Contact List

Sources of Water

Name	Type	Activity	Availability
WELL 2	WL	A	P
WELL 1	WL	A	P

Source Water Percentages

Surface Water	0	Surface Water Purchased	0
Ground Water	100	Ground Water Purchased	0
Ground Water UDI	0	Ground Water UDI Purchased	0

Water Purchases

System No.	System Name	Facility ID	Facility Name	Water Finish
No Water Purchases				

Buyers of Water	
Water System No.	Name
AL0001509	HALE COUNTY WATER AUTHORITY

Annual Operating Period(s)					
Effective Begin Date	Effective End Date	Start Month/Day	End Month/Day	Type	Population
01-28-2008	No End Date	1/1	12/31	R	4200

Service Connections			
Type	Count	Meter Type	Meter Size
RS	1400	ME	0

Service Area	
Code	Name
R	RESIDENTIAL AREA

Regulating Agencies	
Name	Alias/Inspector
ALABAMA DEPT. OF ENVIRONMENTAL MGT.	

Water System Historical Names
Historical Name(s)

System Certification Requirements		
Certification Name	Code	Begin Date

WS Flow Rates		
Type	Quantity	UOM
AVPD - Average Daily Production	1101203	GPD
TLDS - Total Design Capacity	792000	GPD
EMRG - Total Emergency Capacity	1440000	GPD

WS Measures		
Type	Quantity	UOM

WS Indicators		
Type	Value	Date
SSWP - State Source Water Program	NO	03-12-2009

Alabama Department of Environmental Management	Water Division	Drinking Water Branch
County Map of AL	Water System Search	Help

Water System Facilities	Violations Enforcement Actions	TCR Sample Results	TTHM HAA5 Summaries
Sample Points	Assistance Actions	Recent Positive TCR Results	PBCU Summaries
Sample Schedules / FANLs / Plans	Compliance Schedules	Other Chemical Results	Chlorine Summaries
Site Visits Milestones	TOC/Alkalinity Results	Chemical Results by: Name Code	Turbidity Summaries
Operators All POC	LRAA (TTHM/HAA5)	Recent Non-TCR Sample Results	TCR Sample Summaries

Water System Detail Information

Water System No.:	AL0001509	Federal Type:	C
Water System Name:	HALE COUNTY WATER AUTHORITY	Federal Source:	GW
Principal County Served:	HALE	System Status:	A
Principal City Served:	GREENSBORO	Activity Date:	03-01-1979

Water System Contacts

Type	Contact	Communication	
AC - Administrative Contact	THOMAS, RONNIE P. O. Box 416 GREENSBORO, AL 36744		
DO - Designated Operator	SMITHERMAN, AUBREY Artesian Utilities - Corporate Office P O BOX 875 SELMA, AL 36702	**Electronic Type**	**Value**
		EMAIL - Email	asmitherman@artesianwater.net
		Phone Type	**Value**
		BUS - Business	334-875-5607
		MOB - Mobile	334-375-1088
		EMERG - Emergency	334-526-1827
		BUS2 - BUSINESS2	334-382-4281

List of Operators   Complete Point of Contact List

Sources of Water

Name	Type	Activity	Availability
GREENSBORO	CC	A	P
AKRON	CC	A	P
WELL #2	WL	A	P
WELL 1	WL	A	P
WELL 4	WL	A	P
WELL 3	WL	A	P
MOUNDVILLE	CC	A	E
FAUNSDALE WATER WORKS	CC	A	E

Source Water Percentages			
Surface Water	0	Surface Water Purchased	0
Ground Water	60	Ground Water Purchased	40
Ground Water UDI	0	Ground Water UDI Purchased	0

Water Purchases				
System No.	**System Name**	**Facility ID**	**Facility Name**	**Water Finish**
AL0001767	AKRON WATER SYSTEM	DS200	DISTRIBUTION SYSTEM	Not Treated
AL0000909	FAUNSDALE WATER WORKS	DS200	DISTRIBUTION SYSTEM	Treated, not Filtered
AL0000645	GREENSBORO UTILITIES DEPARTMENT	DS200	DISTRIBUTION SYSTEM	Treated, not Filtered
AL0000651	MOUNDVILLE WATER WORKS	DS200	DISTRIBUTION SYSTEM	Treated, not Filtered

Buyers of Water	
Water System No.	**Name**
AL0001767	AKRON WATER SYSTEM
AL0000909	FAUNSDALE WATER WORKS
AL0000914	LINDEN UTILITIES BOARD
AL0001427	PERRY COUNTY WATER AUTHORITY

Annual Operating Period(s)					
Effective Begin Date	**Effective End Date**	**Start Month/Day**	**End Month/Day**	**Type**	**Population**
01-01-2004	No End Date	1/1	12/31	R	8802

Service Connections			
Type	**Count**	**Meter Type**	**Meter Size**
RS	3180	ME	0

Service Area	
Code	**Name**
R	RESIDENTIAL AREA

Regulating Agencies	
Name	**Alias/Inspector**
ALABAMA DEPT. OF ENVIRONMENTAL MGT.	

Water System Historical Names
Historical Name(s)

System Certification Requirements		
Certification Name	**Code**	**Begin Date**

WS Flow Rates		
Type	**Quantity**	**UOM**
AVPD - Average Daily Production	1523773	GPD

WS Measures		
Type	**Quantity**	**UOM**

WS Indicators		
Type	**Value**	**Date**
SSWP - State Source Water Program	NO	03-12-2009

REFERENCE
9

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WATER DIVISION - WATER QUALITY PROGRAM

CHAPTER 335-6-11
WATER USE CLASSIFICATIONS FOR INTERSTATE AND INTRASTATE WATERS

TABLE OF CONTENTS

335-6-11-.01 <u>The Use Classification System</u>.

(1) Use classifications utilized by the State of Alabama are as follows:

Outstanding Alabama Water	OAW
Public Water Supply	PWS
Swimming and Other Whole Body Water-Contact Sports	S
Shellfish Harvesting	SH
Fish and Wildlife	F&W
Limited Warmwater Fishery	LWF
Agricultural and Industrial Water Supply	A&I

(2) Use classifications apply water quality criteria adopted for particular uses based on existing utilization, uses reasonably expected in the future, and those uses not now possible because of correctable pollution but which could be made if the effects of pollution were controlled or eliminated. Of necessity, the assignment of use classifications must take into consideration the physical capability of waters to meet certain uses.

(3) Those use classifications presently included in the standards are reviewed informally by the Department's staff as the need arises, and the entire standards package, to include the use classifications, receives a formal review at least once each three years. Efforts currently underway through local 201 planning projects will provide additional technical data on certain streams in the State, information on treatment alternatives, and applicability of various management techniques, which, when available, will hopefully lead to new decisions regarding use classifications. Of particular interest are those segments which are currently classified for any usage which has an associated degree of quality criteria considered to be less than that applicable to a classification of "Fish and Wildlife." As rapidly as it can be demonstrated that new classifications are feasible and attainable on these segments from an economic and technological viewpoint, based on the information being generated pursuant to water quality studies and the planning efforts previously outlined, such improvement will be proposed. For those segments where such a demonstration cannot be made, use attainability analyses describing in detail

the factors preventing attainment of the "Fish and Wildlife" use will be prepared pursuant to federal requirements and updated as new information becomes available.

(4) Although it is not explicitly stated in the classifications, it should be understood that the use classification of "Shellfish Harvesting" is only applicable in the coastal area and, therefore, is included only in the Mobile River Basin and the Perdido-Escambia River Basin. It should also be noted that with the exception of those segments in the "Public Water Supply" classification, every segment, in addition to being considered acceptable for its designated use, is also considered acceptable for any other use with a less stringent associated criteria.

(5) Not all waters are included by name in the use classifications since it would be a tremendous administrative burden to list all stream segments in the State. In addition, in virtually every instance where a segment is not included by name, the Department has no information or stream data upon which to base a decision relative to the assignment of a particular classification. An effort has been made, however, to include all major stream segments and all segments which, to the Department's knowledge, are currently recipients of point source discharges. Those segments which are not included by name will be considered to be acceptable for a "Fish and Wildlife" classification unless it can be demonstrated that such a generalization is inappropriate in specific instances.

Author: James E. McIndoe.
Statutory Authority: Code of Alabama 1975, §§22-22-9, 22-22A-5, 22-22A-6, 22-22A-8.
History: May 5, 1967. **Amended:** June 19, 1967; April 1, 1970; October 16, 1972; September 17, 1973; May 30, 1977; December 19, 1977; February 4, 1981; April 5, 1982; December 11, 1985; March 26, 1986; September 7, 2000; May 27, 2008.

335-6-11-.02 **Use Classifications.**

(1) **THE ALABAMA RIVER BASIN**

INTERSTATE WATERS

Stream	From	To	Classification
ALABAMA RIVER	MOBILE RIVER	Claiborne Lock and Dam	F&W
ALABAMA RIVER	Claiborne Lock and Dam	Frisco Railroad Crossing	S/F&W
ALABAMA RIVER	Frisco Railroad Crossing	River Mile 131	F&W

(14) **THE WARRIOR RIVER BASIN**

INTRASTATE WATERS

Stream	From	To	Classification
WARRIOR RIVER	TOMBIGBEE RIVER	Five miles upstream from Big Prairie Creek	S/F&W
WARRIOR RIVER	Five miles upstream from Big Prairie Creek	Eight miles upstream from Big Prairie Creek	PWS/S/F&W
WARRIOR RIVER	Eight miles upstream from Big Prairie Creek	Warrior Lock and Dam	S/F&W
WARRIOR RIVER	Warrior Lock and Dam	Oliver Lock and Dam	F&W
WARRIOR RIVER	Oliver Lock and Dam	Hurricane Creek	F&W[1]
WARRIOR RIVER	Hurricane Creek	Bankhead Lock and Dam	S/F&W[1]
WARRIOR RIVER	Bankhead Lock and Dam	Junction of Locust and Mulberry Forks	PWS/S/F&W
Locust Fork	Junction of Locust and Mulberry Forks	Jefferson County Highway 61 (Maxine)	PWS/S/F&W
Locust Fork	Jefferson County Highway 61 (Maxine)	U. S. Highway 31	F&W
Locust Fork	U. S. Highway 31	County road between Hayden and County Line	PWS/F&W
Locust Fork	County road between Hayden and County Line	Its source	F&W
Mulberry Fork	Junction of Locust and Mulberry Forks	Burnt Cane Creek (9 miles below Cordova)	PWS/S/F&W

[1]Applicable dissolved oxygen level below existing impoundments is 4.0 mg/l.

REFERENCE
10

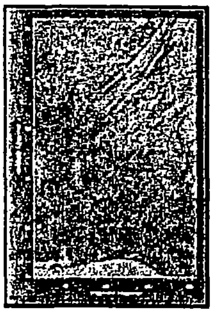
Alabama Ecological Services Field

Southeast Region

- ES Finder
- Service Finder
- Office Finder
- Contact Finder

- General Information
- Staff Directory
- Office Highlights
- Hunting/Fishing Information
- Outreach/Media
- Endangered Species
- Section 7 Consultation
- Environmental Contaminants
- Habitat Conservation Planning
- Partners for Fish and Wildlife
- Tower Site Forms and Information

Alabama's Federally Listed Species



Alabama map. Credit: USFWS

By County - March 2, 2010

We are continually updating this list and, therefore, it may be incomplete and is provided strictly for informational purposes. This list does not constitute any form of Section 7 consultation. We recommend that you contact our office (Daphne, AL Field Office - USFWS) for more current, site specific information prior to project activities. To be certain of occurrence, surveys should be conducted by qualified biologists to determine if a Federally protected species occurs within a project area. Locations of designated critical habitat have also been included for your information. You can also take a look at our critical habitat web portal, featuring CH maps across the country.

Alabama Counties: Autauga / Baldwin / Barbour / Bibb / Blount / Bullock / Butler / Calhoun / Chambers / Cherokee / Chilton / Choctaw / Clarke / Clay / Cleburne / Coffee / Colbert / Conecuh / Coosa / Covington / Crenshaw / Cullman / Dale / Dallas / DeKalb / Elmore / Escambia / Etowah / Fayette / Franklin / Geneva / Greene / Hale / Henry / Houston / Jackson / Jefferson / Lamar / Lauderdale / Lawrence / Lee / Limestone / Lowndes / Macon / Madison / Marengo / Marion / Marshall / Mobile / Monroe / Montgomery / Morgan / Perry / Pickens / Pike / Randolph / Russell / Shelby / St. Clair / Sumter / Talladega / Tallapoosa / Tuscaloosa / Walker / Washington / Wilcox / Winston

Key to codes on list:

- **E** - Endangered
- **T** - Threatened
- **C** - Candidate Species
- **(P)** - Possible Occurrence
- **BGEPA** - Bald & Golden EagleProtection Act

Autauga

Fayette

T - Orange-nacre mucket mussel *Hamiota (= Lampsilis) perovalis*
E - Dark pigtoe mussel *Pleurobema furvum*
T - Fine-lined pocketbook mussel *Hamiota (= Lampsilis) altilis*

<u>Critical Habitat</u>:

- Species—ovate clubshell, triangular kidneyshell, Alabama moccasinshell, orange-nacre mucket, dark pigtoe
- Location—North River, Clear Creek

Franklin

E - Gray bat *Myotis grisescens*
E - Indiana bat *Myotis sodalis* (P)
E - Cumberlandian combshell mussel *Epioblasma brevidens*
T - Lyrate bladder-pod *Lesquerella lyrata*
E - Leafy prairie clover *Dalea foliosa*
E - Tennessee yellow-eyed grass *Xyris tennesseensis*
C - Slabside pearlymussel *Lexingtonia dolabelloides*

Geneva

T - Gulf sturgeon *Acipenser oxyrinchus desotoi*
E - Red-cockaded woodpecker *Picoides borealis*
E - Gentian pinkroot *Spigelia gentianoides var. gentianoides*
C - Southern sandshell *Lampsilis australis*
C - Fuzzy pigtoe *Pleurobema strodeanum*
C - Choctaw bean *Villosa choctawensis*
C - Tapered pigtoe *Quincuncina burkei*

<u>Critical Habitat</u>:

- Species—Gulf sturgeon
- Location—Pea River, Choctawhatchee River

Greene

E - Wood stork *Mycteria americana*
T - Orange-nacre mucket mussel *Hamiota (= Lampsilis) perovalis*
T - Alabama moccasinshell mussel *Medionidus acutissimus*
E - Southern clubshell mussel *Pleurobema decisum*
E - Ovate clubshell mussel *Pleurobema perovatum*
E - Heavy pigtoe mussel *Pleurobema taitianum*
T - Inflated heelsplitter mussel *Potamilus inflatus*
E - Stirrup shell mussel *Quadrula stapes*
E - Mitchell's satyr butterfly *Neonympha mitchellii mitchellii*

<u>Critical Habitat</u>:

- Species—ovate clubshell, southern clubshell, Alabama moccasinshell, orange-nacre mucket
- Location—Sipsey River, Trussel's Creek

Sumter

E - Wood stork *Mycteria americana*
BGEPA - Bald eagle *Haliaeetus leucocephalus*
E - Ovate clubshell mussel *Pleurobema perovatum*
T - Inflated heelsplitter mussel *Potamilus inflatus*
E - Stirrup shell mussel *Quadrula stapes*
E - Heavy pigtoe mussel *Pleurobema taitianum*
T - Gopher tortoise *Gopherus polyphemus*

<u>Critical Habitat</u>:

- Species—ovate clubshell, southern clubshell, Alabama moccasinshell, orange-nacre mucket
- Location—Sucarnoochee River

Talladega

E - Red-cockaded woodpecker *Picoides borealis*
T - Fine-lined pocketbook mussel *Hamiota (=Lampsilis) altilis*
E - Coosa moccasinshell mussel *Medionidus parvulus*
E - Southern pigtoe mussel *Pleurobema georgianum*
E - Southern clubshell *Pleurobema decisum*
E - Triangular kidneyshell *Ptychobranchus greenii*
E - Tulotoma snail *Tulotoma magnifica*
T - Painted rocksnail *Leptoxis taeniata*
T - Lacy elimia (snail) *Elimia crenatella*

<u>Critical Habitat</u>:

- Species—triangular kidneyshell, Coosa moccasinshell, southern pigtoe, fine-lined pocketbook
- Location—Cheaha Creek

Tallapoosa

E - Red-cockaded woodpecker *Picoides borealis*
BGEPA - Bald eagle *Haliaeetus leucocephalus*
T - Fine-lined pocketbook mussel *Hamiota (=Lampsilis) altilis*
T – Little amphianthus *Amphianthus pusillus*

Tuscaloosa

E - Red-cockaded woodpecker *Picoides borealis*
E - Wood stork *Mycteria americana*
BGEPA - Bald eagle *Haliaeetus leucocephalus*
T - Flattened musk turtle *Sternotherus depressus*
E - Southern clubshell mussel *Pleurobema decisum*
E - Dark pigtoe mussel *Pleurobema furvum*
E - Ovate clubshell mussel *Pleurobema perovatum*
T - Alabama moccasinshell mussel *Medionidus acutissimus*
T - Inflated heelsplitter mussel *Potamilus inflatus*
T - Fine-lined pocketbook mussel *Hamiota (=Lampsilis) altilis*
T - Orange-nacre mucket mussel *Hamiota (=Lampsilis) perovalis*

C - Black Warrior waterdog *Necturus alabamensis*
C - White fringeless orchid *Platanthera integrilabia*

Critical Habitat:

- Species—ovate clubshell, southern clubshell, Alabama moccasinshell, orange-nacre mucket, triangular kidneyshell, dark pigtoe
- Location North River, Sipsey River

Walker

T - Flattened musk turtle *Sternotherus depressus*
E - Ovate clubshell mussel *Pleurobema perovatum*
E - Triangular kidneyshell mussel *Ptychobranchus greenii*
T - Fine-lined pocketbook mussel *Hamiota (=Lampsilis) altilis*
T - Mohr's Barbara's buttons *Marshallia mohrii*
C - Black Warrior waterdog *Necturus alabamensis*

Washington

E - Wood stork *Mycteria americana*
T - Gopher tortoise *Gopherus polyphemus*
T - Gulf sturgeon *Acipenser oxyrinchus desotoi*
T - Inflated heelsplitter mussel *Potamilus inflatus*
E - Louisiana quillwort *Isoetes louisianensis* (P)
C - Black pine snake *Pituophis melanoleucus lodingi*

Wilcox

BGEPA - Bald eagle *Haliaeetus leucocephalus*
E - Wood stork *Mycteria americana* (P)
T - Red hills salamander *Phaegnathus hubrichti*
T - Gulf sturgeon Acipenser *oxyrinchus desotoi*
E - Alabama sturgeon *Scaphirhynchus suttkusi*
E - Heavy pigtoe mussel *Pleurobema taitianum* (P)
C - Alabama pearlshell *Margaritifera marrianae*
C - Georgia rockcress *Arabis georgiana*

Winston

T - Flattened musk turtle *Sternotherus depressus*
E - Red-cockaded woodpecker *Picoides borealis*
T - Orange-nacre mucket mussel *Hamiota (=Lampsilis) perovalis*
T - Alabama moccasinshell mussel *Medionidus acutissimus*
E - Coosa moccasinshell mussel *Medionidus parvulus*
E - Dark pigtoe mussel *Pleurobema furvum*
E - Triangular kidneyshell mussel *Ptychobranchus greenii*
T - Fine-lined pocketbook mussel *Hamiota (=Lampsilis) altilis*
E - Ovate clubshell mussel *Pleurobema perovatum*
T - Kral's water-plantain *Sagittaria secundifolia*
T - Alabama streak-sorus fern *Thelypteris pilosa var. alabamensis*
C - Rush darter *Etheostoma phytophilum*
C - Black Warrior waterdog *Necturus alabamensis*

REFERENCE 11

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science for a changing world

02462500 BLACK WARRIOR RIVER AT BANKHEAD LOCK AND DAM NEAR BESSEMER, AL

Black Warrior-Tombigbee Basin
Upper Black Warrior Subbasin

LOCATION.--Lat 33°27'30", long 87°21'15" referenced to North American Datum of 1927, Tuscaloosa County, AL, Hydrologic Unit 03160112, at abandoned lock wall 300 ft above dam, 1.9 mi downstream from Big Yellow Creek, 23 mi northwest of Bessemer, and at mile 153.6.

DRAINAGE AREA.--3,981 mi^2.

SURFACE-WATER RECORDS

PERIOD OF RECORD.--October 1928 to September 1936, October 1976 to current year.

REVISED RECORDS.-- WDR AL-84-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is NGVD of 1929. Prior to October 1, 1998, gage datum was 173.50 ft higher.

COOPERATION.--Records were provided by Alabama Power Company.

02462500 BLACK WARRIOR RIVER AT BANKHEAD LOCK AND DAM NEAR BESSEMER, AL—Continued

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2008 TO SEPTEMBER 2009
DAILY MEAN VALUES

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	0	0	10,700	1,230	62,900	16,800	3,040	4,760	2,430	5,730	4,420
2	0	0	1,750	10,700	4,940	34,100	18,000	6,300	3,450	1,810	2,620	1,640
3	0	0	1,960	10,700	6,370	14,100	24,400	15,000	2,570	1,300	3,310	1,550
4	0	0	1,250	10,700	7,180	13,100	16,400	19,700	3,970	0	2,540	1,510
5	0	0	2,140	10,600	6,130	10,100	17,100	19,200	6,490	0	2,540	3,590
6	0	0	1,350	75,600	5,960	10,500	11,400	15,200	2,360	3,240	2,100	967
7	0	0	0	124,000	3,730	10,500	12,500	24,900	2,550	1,810	2,380	2,080
8	0	0	2,130	93,200	3,150	10,400	12,100	26,000	2,830	2,400	1,410	2,820
9	0	135	1,360	74,700	3,140	3,000	10,300	17,400	2,520	1,760	0	3,370
10	953	0	9,350	20,700	3,160	3,880	6,740	17,500	2,180	1,750	2,200	2,960
11	0	0	22,800	24,900	3,720	4,650	8,900	19,500	2,270	1,730	2,280	5,500
12	0	936	29,800	18,500	5,440	5,240	8,750	18,000	2,380	0	1,970	5,990
13	0	1,070	13,600	18,500	4,670	6,990	11,600	18,000	4,360	5,100	2,090	2,580
14	1,010	833	7,400	15,400	2,690	8,300	24,100	21,500	7,970	6,910	2,990	2,570
15	812	0	4,990	10,500	2,530	28,400	18,100	15,200	11,800	2,530	1,580	2,990
16	0	272	6,760	10,500	3,940	31,700	11,000	14,900	6,730	2,140	1,810	4,700
17	0	574	12,100	10,500	3,780	23,800	10,400	17,500	7,710	3,930	3,240	4,010
18	0	0	17,600	10,500	4,000	12,000	7,620	19,900	5,120	1,300	3,070	8,140
19	0	0	11,000	10,500	3,460	10,600	7,380	17,300	4,430	0	1,820	28,100
20	0	0	8,830	10,300	3,940	10,600	9,280	5,140	1,410	2,130	2,630	27,900
21	0	0	8,300	10,300	2,620	7,460	12,800	2,800	1,040	2,420	2,260	23,500
22	917	0	8,900	9,570	2,220	7,840	10,200	4,520	3,530	2,000	6,750	20,200
23	386	0	10,800	8,200	3,100	10,100	6,810	2,430	2,830	1,510	2,170	12,400
24	0	0	10,600	6,380	2,930	10,400	6,390	7,210	1,910	1,850	2,250	13,000
25	0	179	10,500	3,930	2,580	11,900	3,640	10,500	2,130	1,320	960	10,500
26	0	0	10,500	7,130	4,000	44,200	1,550	10,300	2,190	0	1,790	33,800
27	0	0	10,400	5,380	11,000	43,100	3,120	8,200	976	1,740	1,660	38,000
28	0	0	10,700	5,690	72,500	32,700	5,160	3,020	0	1,640	1,330	11,100
29	0	1,370	10,800	5,230	---	32,700	3,870	6,990	2,980	1,560	404	10,500
30	0	0	10,800	5,660	---	23,600	2,870	3,180	2,040	2,200	3,070	7,530
31	1,270	---	10,700	4,880	---	18,400	---	3,020	---	3,030	2,560	---
Total	5,348	5,369	269,170	654,050	184,110	557,260	319,280	393,350	107,486	61,540	73,514	297,917
Mean	173	179	8,683	21,100	6,575	17,980	10,640	12,690	3,583	1,985	2,371	9,931
Max	1,270	1,370	29,800	124,000	72,500	62,900	24,400	26,000	11,800	6,910	6,750	38,000
Min	0	0	0	3,930	1,230	3,000	1,550	2,430	0	0	0	967
Cfsm	0.04	0.04	2.18	5.30	1.65	4.52	2.67	3.19	0.90	0.50	0.60	2.49
In.	0.05	0.05	2.52	6.11	1.72	5.21	2.98	3.68	1.00	0.58	0.69	2.78

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1929 - 2009, BY WATER YEAR (WY)

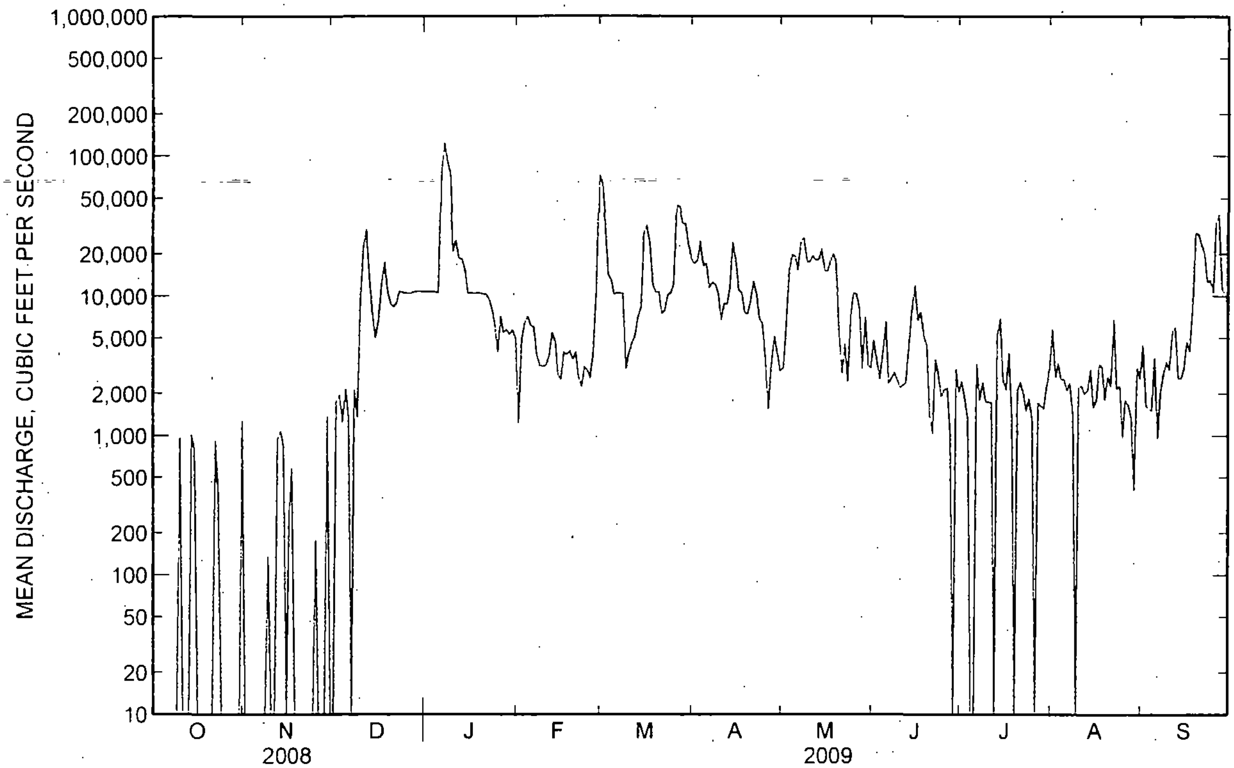
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	2,271	4,513	7,588	10,960	11,870	13,630	9,990	6,289	3,333	2,954	1,962	2,262
Max	11,990	32,560	32,480	24,030	35,550	38,030	29,230	27,260	21,670	13,400	4,557	9,931
(WY)	(1933)	(1930)	(1933)	(1998)	(1990)	(1929)	(1979)	(2003)	(1997)	(1989)	(1985)	(2009)
Min	15.2	1.97	85.2	500	2,464	2,263	841	315	182	410	404	65.4
(WY)	(2008)	(2008)	(2008)	(2008)	(2000)	(2007)	(1986)	(2007)	(1936)	(1931)	(1929)	(1931)

02462500 BLACK WARRIOR RIVER AT BANKHEAD LOCK AND DAM NEAR BESSEMER, AL—Continued

SUMMARY STATISTICS

	Calendar Year 2008		Water Year 2009		Water Years 1929 - 2009	
Annual total	1,257,354		2,928,394			
Annual mean	3,435		8,023		6,443	
Highest annual mean					10,210	1980
Lowest annual mean					2,526	2007
Highest daily mean	33,500	May 16	124,000	Jan 7	143,000	Apr 13, 1979
Lowest daily mean	[a]0	Many days	[a]0	Many days	[a]0	Many days
Annual seven-day minimum	[a]0	Jan 17	[a]0	Oct 1	[a]0	Sep 29, 1931
Maximum peak flow					143,000	Apr 13, 1979
Maximum peak stage					255.60	Jan 11, 1984
Annual runoff (cfsm)	0.863		2.02		1.62	
Annual runoff (inches)	11.75		27.36		21.99	
10 percent exceeds	9,870		18,400		14,400	
50 percent exceeds	1,760		3,720		2,990	
90 percent exceeds	[a]0		[a]0		240	

[a] Some undetermined amounts of leakage may have occurred during periods reported as zero flow.

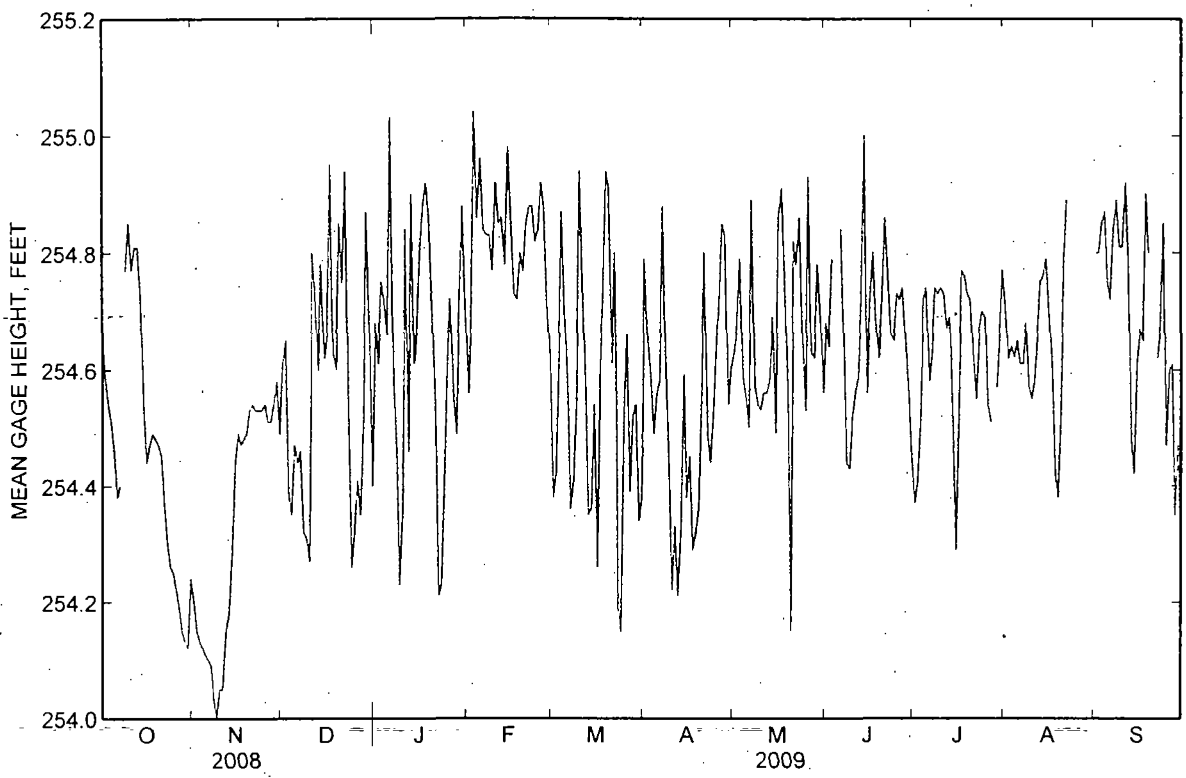


02462500 BLACK WARRIOR RIVER AT BANKHEAD LOCK AND DAM NEAR BESSEMER, AL—Continued

GAGE HEIGHT, FEET
WATER YEAR OCTOBER 2008 TO SEPTEMBER 2009
DAILY MEAN VALUES

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	254.65	254.20	254.61	254.68	254.56	254.38	254.79	254.63	254.68	254.37	254.71	254.80
2	254.59	254.15	254.65	254.61	254.69	254.42	254.65	254.67	254.64	254.41	254.62	254.80
3	254.54	254.13	254.39	254.75	255.04	254.61	254.59	254.79	254.79	254.51	254.64	254.85
4	254.51	254.12	254.35	254.72	254.86	254.87	254.49	254.59	---	254.72	254.62	254.87
5	254.46	254.11	254.47	254.66	254.96	254.70	254.56	254.55	---	254.74	254.65	254.75
6	254.38	254.10	254.44	255.03	254.84	254.57	254.58	254.50	254.84	254.58	254.61	254.72
7	254.40	254.09	254.46	254.58	254.83	254.36	254.88	254.89	254.65	254.63	254.61	254.84
8	---	254.03	254.32	254.46	254.83	254.41	254.61	254.57	254.44	254.74	254.68	254.89
9	254.77	254.00	254.31	254.23	254.77	254.54	254.45	254.54	254.43	254.73	254.57	254.81
10	254.85	254.05	254.27	254.36	254.92	254.94	254.22	254.53	254.52	254.74	254.55	254.81
11	254.77	254.05	254.80	254.84	254.85	254.76	254.33	254.56	254.56	254.73	254.58	254.92
12	254.81	254.15	254.74	254.46	254.86	254.56	254.21	254.56	254.59	254.67	254.66	254.78
13	254.81	254.18	254.60	254.90	254.78	254.35	254.33	254.58	254.72	254.69	254.75	254.48
14	254.73	254.29	254.78	254.61	254.98	254.36	254.59	254.69	255.00	254.51	254.76	254.42
15	254.53	254.44	254.62	254.67	254.86	254.54	254.38	254.49	254.56	254.29	254.79	254.61
16	254.44	254.49	254.66	254.81	254.73	254.26	254.45	254.86	254.71	254.52	254.70	254.67
17	254.47	254.47	254.95	254.88	254.72	254.61	254.29	254.91	254.80	254.77	254.61	254.65
18	254.49	254.48	254.63	254.92	254.80	254.72	254.32	254.76	254.68	254.76	254.42	254.90
19	254.48	254.49	254.60	254.86	254.77	254.94	254.36	254.55	254.62	254.73	254.38	254.80
20	254.47	254.53	254.85	254.71	254.85	254.91	254.55	254.15	254.72	254.72	254.53	---
21	254.45	254.54	254.75	254.52	254.88	254.61	254.80	254.82	254.86	254.62	254.79	---
22	254.37	254.53	254.94	254.21	254.88	254.80	254.49	254.78	254.77	254.55	254.89	254.62
23	254.30	254.53	254.53	254.23	254.82	254.19	254.44	254.86	254.66	254.67	---	254.67
24	254.26	254.53	254.26	254.41	254.84	254.15	254.53	254.65	254.65	254.70	---	254.85
25	254.25	254.54	254.32	254.62	254.92	254.53	254.65	254.53	254.73	254.69	---	254.47
26	254.22	254.51	254.41	254.72	254.88	254.66	254.70	254.93	254.72	254.54	---	254.60
27	254.19	254.51	254.35	254.55	254.71	254.39	254.85	254.63	254.74	254.51	---	254.61
28	254.15	254.54	254.52	254.49	254.63	254.52	254.83	254.62	254.65	---	---	254.35
29	254.13	254.58	254.87	254.71	---	254.54	254.54	254.78	254.56	254.57	---	254.47
30	254.12	254.49	254.67	254.88	---	254.34	254.60	254.70	254.45	254.66	---	254.29
31	254.24	---	254.40	254.71	---	254.38	---	254.56	---	254.77	---	---
Mean	---	254.33	254.57	254.64	254.82	254.55	254.54	254.65	---	---	---	---
Max	---	254.58	254.95	255.03	255.04	254.94	254.88	254.93	---	---	---	---
Min	---	254.00	254.26	254.21	254.56	254.15	254.21	254.15	---	---	---	---

02462500 BLACK WARRIOR RIVER AT BANKHEAD LOCK AND DAM NEAR BESSEMER, AL—Continued



REFERENCE
12

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic area: Tuscaloosa County, Alabama

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**164,875**	**100.0**
SEX AND AGE		
Male	79,372	48.1
Female	85,503	51.9
Under 5 years	10,592	6.4
5 to 9 years	10,853	6.6
10 to 14 years	10,690	6.5
15 to 19 years	14,558	8.8
20 to 24 years	19,125	11.6
25 to 34 years	22,959	13.9
35 to 44 years	23,319	14.1
45 to 54 years	21,366	13.0
55 to 59 years	7,073	4.3
60 to 64 years	5,775	3.5
65 to 74 years	10,391	6.3
75 to 84 years	6,115	3.7
85 years and over	2,059	1.2
Median age (years)	31.9	(X)
18 years and over	126,332	76.6
Male	59,677	36.2
Female	66,655	40.4
21 years and over	113,451	68.8
62 years and over	21,849	13.3
65 years and over	18,565	11.3
Male	7,497	4.5
Female	11,068	6.7
RACE		
One race	163,518	99.2
White	112,320	68.1
Black or African American	48,327	29.3
American Indian and Alaska Native	372	0.2
Asian	1,516	0.9
Asian Indian	297	0.2
Chinese	524	0.3
Filipino	129	0.1
Japanese	166	0.1
Korean	198	0.1
Vietnamese	67	-
Other Asian [1]	135	0.1
Native Hawaiian and Other Pacific Islander	52	-
Native Hawaiian	12	-
Guamanian or Chamorro	32	-
Samoan	4	-
Other Pacific Islander [2]	4	-
Some other race	931	0.6
Two or more races	1,357	0.8
Race alone or in combination with one or more other races: [3]		
White	113,445	68.8
Black or African American	48,780	29.6
American Indian and Alaska Native	957	0.6
Asian	1,824	1.1
Native Hawaiian and Other Pacific Islander	119	0.1
Some other race	1,246	0.8

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**164,875**	**100.0**
Hispanic or Latino (of any race)	2,130	1.3
Mexican	1,126	0.7
Puerto Rican	178	0.1
Cuban	103	0.1
Other Hispanic or Latino	723	0.4
Not Hispanic or Latino	162,745	98.7
White alone	111,367	67.5
RELATIONSHIP		
Total population	**164,875**	**100.0**
In households	156,184	94.7
Householder	64,517	39.1
Spouse	30,473	18.5
Child	44,740	27.1
Own child under 18 years	34,138	20.7
Other relatives	8,277	5.0
Under 18 years	3,748	2.3
Nonrelatives	8,177	5.0
Unmarried partner	2,233	1.4
In group quarters	8,691	5.3
Institutionalized population	2,447	1.5
Noninstitutionalized population	6,244	3.8
HOUSEHOLD BY TYPE		
Total households	**64,517**	**100.0**
Family households (families)	41,689	64.6
With own children under 18 years	19,559	30.3
Married-couple family	30,473	47.2
With own children under 18 years	13,262	20.6
Female householder, no husband present	9,036	14.0
With own children under 18 years	5,337	8.3
Nonfamily households	22,828	35.4
Householder living alone	18,304	28.4
Householder 65 years and over	5,354	8.3
Households with individuals under 18 years	21,692	33.6
Households with individuals 65 years and over	13,219	20.5
Average household size	2.42	(X)
Average family size	3.00	(X)
HOUSING OCCUPANCY		
Total housing units	**71,429**	**100.0**
Occupied housing units	64,517	90.3
Vacant housing units	6,912	9.7
For seasonal, recreational, or occasional use	489	0.7
Homeowner vacancy rate (percent)	1.7	(X)
Rental vacancy rate (percent)	12.3	(X)
HOUSING TENURE		
Occupied housing units	**64,517**	**100.0**
Owner-occupied housing units	40,946	63.5
Renter-occupied housing units	23,571	36.5
Average household size of owner-occupied units	2.58	(X)
Average household size of renter-occupied units	2.14	(X)

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

Table DP-2. Profile of Selected Social Characteristics: 2000

Geographic area: Tuscaloosa County, Alabama

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
SCHOOL ENROLLMENT		
Population 3 years and over enrolled in school	**52,373**	**100.0**
Nursery school, preschool	2,668	5.1
Kindergarten	2,534	4.8
Elementary school (grades 1-8)	17,366	33.2
High school (grades 9-12)	8,664	16.5
College or graduate school	21,141	40.4
EDUCATIONAL ATTAINMENT		
Population 25 years and over	**99,039**	**100.0**
Less than 9th grade	6,418	6.5
9th to 12th grade, no diploma	14,563	14.7
High school graduate (includes equivalency)	28,115	28.4
Some college, no degree	20,774	21.0
Associate degree	5,365	5.4
Bachelor's degree	14,193	14.3
Graduate or professional degree	9,611	9.7
Percent high school graduate or higher	78.8	(X)
Percent bachelor's degree or higher	24.0	(X)
MARITAL STATUS		
Population 15 years and over	**132,737**	**100.0**
Never married	43,574	32.8
Now married, except separated	65,449	49.3
Separated	2,555	1.9
Widowed	8,842	6.7
Female	7,395	5.6
Divorced	12,317	9.3
Female	7,322	5.5
GRANDPARENTS AS CAREGIVERS		
Grandparent living in household with one or more own grandchildren under 18 years	**3,424**	**100.0**
Grandparent responsible for grandchildren	1,929	56.3
VETERAN STATUS		
Civilian population 18 years and over	**126,162**	**100.0**
Civilian veterans	15,264	12.1
DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION		
Population 5 to 20 years	**41,107**	**100.0**
With a disability	3,946	9.6
Population 21 to 64 years	**93,629**	**100.0**
With a disability	19,245	20.6
Percent employed	48.3	(X)
No disability	74,384	79.4
Percent employed	75.4	(X)
Population 65 years and over	**17,740**	**100.0**
With a disability	8,610	48.5
RESIDENCE IN 1995		
Population 5 years and over	**154,505**	**100.0**
Same house in 1995	78,867	51.0
Different house in the U.S. in 1995	73,233	47.4
Same county	42,971	27.8
Different county	30,262	19.6
Same state	18,712	12.1
Different state	11,550	7.5
Elsewhere in 1995	2,405	1.6
NATIVITY AND PLACE OF BIRTH		
Total population	**164,875**	**100.0**
Native	161,416	97.9
Born in United States	160,404	97.3
State of residence	125,713	76.2
Different state	34,691	21.0
Born outside United States	1,012	0.6
Foreign born	3,459	2.1
Entered 1990 to March 2000	2,056	1.2
Naturalized citizen	1,098	0.7
Not a citizen	2,361	1.4
REGION OF BIRTH OF FOREIGN BORN		
Total (excluding born at sea)	**3,459**	**100.0**
Europe	998	28.9
Asia	1,364	39.4
Africa	23	0.7
Oceania	-	-
Latin America	960	27.8
Northern America	114	3.3
LANGUAGE SPOKEN AT HOME		
Population 5 years and over	**154,505**	**100.0**
English only	147,682	95.6
Language other than English	6,823	4.4
Speak English less than "very well"	2,562	1.7
Spanish	3,205	2.1
Speak English less than "very well"	1,158	0.7
Other Indo-European languages	2,154	1.4
Speak English less than "very well"	623	0.4
Asian and Pacific Island languages	1,209	0.8
Speak English less than "very well"	627	0.4
ANCESTRY (single or multiple)		
Total population	**164,875**	**100.0**
Total ancestries reported	*129,938*	*78.8*
Arab	242	0.1
Czech[1]	229	0.1
Danish	123	0.1
Dutch	1,702	1.0
English	13,325	8.1
French (except Basque)[1]	2,574	1.6
French Canadian[1]	218	0.1
German	9,383	5.7
Greek	192	0.1
Hungarian	191	0.1
Irish[1]	12,300	7.5
Italian	1,673	1.0
Lithuanian	55	-
Norwegian	616	0.4
Polish	830	0.5
Portuguese	40	-
Russian	286	0.2
Scotch-Irish	3,604	2.2
Scottish	2,911	1.8
Slovak	43	-
Subsaharan African	1,480	0.9
Swedish	478	0.3
Swiss	59	-
Ukrainian	45	-
United States or American	22,416	13.6
Welsh	692	0.4
West Indian (excluding Hispanic groups)	247	0.1
Other ancestries	53,984	32.7

-Represents zero or rounds to zero. (X) Not applicable.

[1]The data represent a combination of two ancestries shown separately in Summary File 3. Czech includes Czechoslovakian. French includes Alsatian. French Canadian includes Acadian/Cajun. Irish includes Celtic.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-3. Profile of Selected Economic Characteristics: 2000

Geographic area: Tuscaloosa County, Alabama

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
EMPLOYMENT STATUS		
Population 16 years and over	**130,752**	**100.0**
In labor force	79,425	60.7
Civilian labor force	79,287	60.6
Employed	74,397	56.9
Unemployed	4,890	3.7
Percent of civilian labor force	6.2	(X)
Armed Forces	138	0.1
Not in labor force	51,327	39.3
Females 16 years and over	**68,920**	**100.0**
In labor force	37,858	54.9
Civilian labor force	37,856	54.9
Employed	35,310	51.2
Own children under 6 years	**11,993**	**100.0**
All parents in family in labor force	7,480	62.4
COMMUTING TO WORK		
Workers 16 years and over	**73,292**	**100.0**
Car, truck, or van - - drove alone	61,537	84.0
Car, truck, or van - - carpooled	7,799	10.6
Public transportation (including taxicab)	357	0.5
Walked	1,629	2.2
Other means	489	0.7
Worked at home	1,481	2.0
Mean travel time to work (minutes)[1]	21.2	(X)
Employed civilian population 16 years and over	**74,397**	**100.0**
OCCUPATION		
Management, professional, and related occupations	23,823	32.0
Service occupations	10,462	14.1
Sales and office occupations	20,186	27.1
Farming, fishing, and forestry occupations	304	0.4
Construction, extraction, and maintenance occupations	7,196	9.7
Production, transportation, and material moving occupations	12,426	16.7
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	1,577	2.1
Construction	5,097	6.9
Manufacturing	10,884	14.6
Wholesale trade	2,399	3.2
Retail trade	9,992	13.4
Transportation and warehousing, and utilities	2,603	3.5
Information	1,341	1.8
Finance, insurance, real estate, and rental and leasing	3,348	4.5
Professional, scientific, management, administrative, and waste management services	5,175	7.0
Educational, health and social services	20,456	27.5
Arts, entertainment, recreation, accommodation and food services	5,173	7.0
Other services (except public administration)	3,684	5.0
Public administration	2,668	3.6
CLASS OF WORKER		
Private wage and salary workers	56,069	75.4
Government workers	14,859	20.0
Self-employed workers in own not incorporated business	3,173	4.3
Unpaid family workers	296	0.4

Subject	Number	Percent
INCOME IN 1999		
Households	**64,517**	**100.0**
Less than $10,000	10,322	16.0
$10,000 to $14,999	4,902	7.6
$15,000 to $24,999	9,185	14.2
$25,000 to $34,999	8,228	12.8
$35,000 to $49,999	10,040	15.6
$50,000 to $74,999	11,320	17.5
$75,000 to $99,999	5,474	8.5
$100,000 to $149,999	3,261	5.1
$150,000 to $199,999	850	1.3
$200,000 or more	935	1.4
Median household income (dollars)	34,436	(X)
With earnings	51,184	79.3
Mean earnings (dollars)[1]	46,645	(X)
With Social Security income	15,627	24.2
Mean Social Security income (dollars)[1]	10,688	(X)
With Supplemental Security Income	3,242	5.0
Mean Supplemental Security Income (dollars)[1]	5,510	(X)
With public assistance income	1,041	1.6
Mean public assistance income (dollars)[1]	2,449	(X)
With retirement income	11,343	17.6
Mean retirement income (dollars)[1]	17,401	(X)
Families	**42,107**	**100.0**
Less than $10,000	3,238	7.7
$10,000 to $14,999	2,137	5.1
$15,000 to $24,999	4,970	11.8
$25,000 to $34,999	5,545	13.2
$35,000 to $49,999	7,409	17.6
$50,000 to $74,999	9,455	22.5
$75,000 to $99,999	4,908	11.7
$100,000 to $149,999	2,941	7.0
$150,000 to $199,999	747	1.8
$200,000 or more	757	1.8
Median family income (dollars)	45,485	(X)
Per capita income (dollars)[1]	18,998	(X)
Median earnings (dollars):		
Male full-time, year-round workers	34,807	(X)
Female full-time, year-round workers	24,128	(X)

Subject	Number below poverty level	Percent below poverty level
POVERTY STATUS IN 1999		
Families	**4,740**	**11.3**
With related children under 18 years	3,533	16.2
With related children under 5 years	1,805	21.4
Families with female householder, no husband present	**2,990**	**33.0**
With related children under 18 years	2,562	40.6
With related children under 5 years	1,336	52.0
Individuals	**26,633**	**17.0**
18 years and over	19,094	16.2
65 years and over	2,344	13.2
Related children under 18 years	7,439	19.5
Related children 5 to 17 years	5,082	18.3
Unrelated individuals 15 years and over	11,420	38.2

-Represents zero or rounds to zero. (X) Not applicable.

[1]If the denominator of a mean value or per capita value is less than 30, then that value is calculated using a rounded aggregate in the numerator. See text.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-4. Profile of Selected Housing Characteristics: 2000

Geographic area: Tuscaloosa County, Alabama

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total housing units	**71,429**	**100.0**
UNITS IN STRUCTURE		
1-unit, detached	41,772	58.5
1-unit, attached	1,568	2.2
2 units	1,561	2.2
3 or 4 units	3,926	5.5
5 to 9 units	3,688	5.2
10 to 19 units	3,184	4.5
20 or more units	5,462	7.6
Mobile home	10,237	14.3
Boat, RV, van, etc	31	-
YEAR STRUCTURE BUILT		
1999 to March 2000	1,893	2.7
1995 to 1998	8,957	12.5
1990 to 1994	8,060	11.3
1980 to 1989	12,824	18.0
1970 to 1979	15,197	21.3
1960 to 1969	9,737	13.6
1940 to 1959	11,494	16.1
1939 or earlier	3,267	4.6
ROOMS		
1 room	766	1.1
2 rooms	2,912	4.1
3 rooms	6,600	9.2
4 rooms	12,240	17.1
5 rooms	17,148	24.0
6 rooms	13,574	19.0
7 rooms	8,377	11.7
8 rooms	5,144	7.2
9 or more rooms	4,668	6.5
Median (rooms)	5.3	(X)
Occupied housing units	**64,517**	**100.0**
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	15,453	24.0
1995 to 1998	19,247	29.8
1990 to 1994	9,937	15.4
1980 to 1989	8,138	12.6
1970 to 1979	5,789	9.0
1969 or earlier	5,953	9.2
VEHICLES AVAILABLE		
None	5,405	8.4
1	22,268	34.5
2	23,583	36.6
3 or more	13,261	20.6
HOUSE HEATING FUEL		
Utility gas	26,002	40.3
Bottled, tank, or LP gas	4,387	6.8
Electricity	33,232	51.5
Fuel oil, kerosene, etc	174	0.3
Coal or coke	21	-
Wood	533	0.8
Solar energy	-	-
Other fuel	74	0.1
No fuel used	94	0.1
SELECTED CHARACTERISTICS		
Lacking complete plumbing facilities	284	0.4
Lacking complete kitchen facilities	278	0.4
No telephone service	1,716	2.7

Subject	Number	Percent
OCCUPANTS PER ROOM		
Occupied housing units	**64,517**	**100.0**
1.00 or less	62,565	97.0
1.01 to 1.50	1,424	2.2
1.51 or more	528	0.8
Specified owner-occupied units	**30,790**	**100.0**
VALUE		
Less than $50,000	2,626	8.5
$50,000 to $99,999	11,310	36.7
$100,000 to $149,999	9,662	31.4
$150,000 to $199,999	3,716	12.1
$200,000 to $299,999	2,322	7.5
$300,000 to $499,999	777	2.5
$500,000 to $999,999	293	1.0
$1,000,000 or more	84	0.3
Median (dollars)	106,600	(X)
MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS		
With a mortgage	21,329	69.3
Less than $300	326	1.1
$300 to $499	1,547	5.0
$500 to $699	3,811	12.4
$700 to $999	7,144	23.2
$1,000 to $1,499	5,879	19.1
$1,500 to $1,999	1,668	5.4
$2,000 or more	954	3.1
Median (dollars)	902	(X)
Not mortgaged	9,461	30.7
Median (dollars)	243	(X)
SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	12,496	40.6
15.0 to 19.9 percent	5,239	17.0
20.0 to 24.9 percent	4,325	14.0
25.0 to 29.9 percent	2,385	7.7
30.0 to 34.9 percent	1,742	5.7
35.0 percent or more	4,188	13.6
Not computed	415	1.3
Specified renter-occupied units	**23,285**	**100.0**
GROSS RENT		
Less than $200	1,660	7.1
$200 to $299	2,020	8.7
$300 to $499	7,826	33.6
$500 to $749	7,685	33.0
$750 to $999	1,706	7.3
$1,000 to $1,499	744	3.2
$1,500 or more	179	0.8
No cash rent	1,465	6.3
Median (dollars)	487	(X)
GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	3,727	16.0
15.0 to 19.9 percent	2,793	12.0
20.0 to 24.9 percent	2,255	9.7
25.0 to 29.9 percent	1,912	8.2
30.0 to 34.9 percent	1,629	7.0
35.0 percent or more	8,422	36.2
Not computed	2,547	10.9

-Represents zero or rounds to zero. (X) Not applicable.

Source: U.S. Bureau of the Census, Census 2000.

ATTACHMENT

1

U.S. EPA REGION IV

SDMS

Unscannable Material Target Sheet

DocID: 10847760 Site ID: ALD000472712

Site Name: Cracker Asphalt

Nature of Material:

Map:	☒	Computer Disks:	☐
Photos:	☐	CD-ROM:	☐
Blueprints:	☐	Oversized Report:	☐
Slides:	☐	Log Book:	☐

Other (describe): Radius Map

Amount of material:

* Please contact the appropriate Records Center to view the material *

ATTACHMENT
2

Lance R. LeFleur
Director

Robert J. Bentley
Governor

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ■ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ■ FAX (334) 271-7950

March 2, 2011

To: Dave Davis, Chief
Assessment Section
Environmental Services Branch
Land Division

From: Dylan C. Hendrix, ES
Assessment Section
Environmental Services Branch
Land Division

RE: Trip Report for Site Reassessment
Cracker Asphalt
CERCLA ID No. AL0000472712
Cracker Asphalt Road
Moundville, Alabama 35474

On December 9, 2010, Mr. Dylan Hendrix and Mr. Michael Cruise conducted a site visit at the Cracker Asphalt facility in Moundville, Tuscaloosa County, Alabama. The current business operating on-site is B&W Heads, which manufactures tank heads and compound dishing for ship builders. The current owner of the site is Anne Wesselhoeft Smalley, daughter of Conrad Wesselhoeft, who originally purchased the Cracker Asphalt site in the late 1960's.

At 10:15 a.m. we arrived on-site and met with Mr. Conrad Wesselhoeft and Ms. Anne Smalley. We introduced ourselves and explained the purpose of our visit and the scope of the assessment to be performed. I asked Mr. Wesselhoeft if he was the previous owner of the property to the west of the site, and he confirmed that he had been a partial owner of the Southern Resin Company before it was sold to Lawter International. A review of tax records shows that the current owner of the former Southern Resin Company site is Green River Biodiesel, Inc. Mr. Wesselhoeft stated that Green River Biodiesel ceased operations eight months prior to this inspection. We then discussed the issue of the groundwater contamination underlying both the Cracker Asphalt site and the Green River Biodiesel property. Mr. Wesselhoeft stated that he had contracted an environmental consultant, Environmental Testing & Engineering, to conduct groundwater monitoring at the Cracker Asphalt site. Mr. Wesselfhoeft stated that Mr. John Haddock (Environmental Testing & Engineering) had been responsible for groundwater monitoring at the site, and that they had ceased monitoring five or six years ago based on data that suggested attenuation of contaminants in the groundwater. I asked Mr. Wesselhoeft about the multiple tanks and drums on-site and he stated that they had not been removed and that some of the tanks still contained bottoms.

At 10:50 a.m. Mr. Cruise and I began our walkthrough of the Cracker Asphalt site; Mr. Cruise collected photographs while I made logbook entries. We first evaluated the large shed and tank head manufacturing area directly southeast of the Cracker Asphalt Road loop. At the west end of the open shed, we discovered eight drums (55-gallon) that appeared to contain a product labeled "AW OIL #96". The drums did not appear to be leaking at the time of inspection. Along the north side of the shed, there were signs that asphalt had leaked down the sides of the cinderblock foundation. There were also chunks of solidified asphalt on the ground directly north of the shed, near a group of large-capacity asphalt tanks. This group of asphalt tanks is located east of the Cracker Asphalt Road loop and directly north of the large shed and tank head manufacturing area. There was evidence of spilled or discarded asphalt and tar on the ground near the tanks. It appeared that one tank had been cut away from its base and removed, leaving about two feet of solidified tank bottoms open to the elements.

At 11:15 a.m. we assessed the former cooling pond area located in the center of the Cracker Asphalt Road loop. We discovered 18 drums (55-gallon) in this area, and some appeared to contain solids and liquids while others were empty. We observed several structures within the area of the former cooling pond that appeared to be small asphalt skimmers. Standing water in some areas near the former cooling pond exhibited an oily sheen on the surface.

At 11:25 a.m. we walked to the northeast corner of the Cracker Asphalt Road loop and observed four large-capacity asphalt tanks in that area. We again observed areas of stained soil and areas where asphalt or tar was solidified on the ground. One of the asphalt tanks in this area had an open portal at the base and there appeared to be two feet of liquid asphalt or tar remaining in the tank. We then proceeded to evaluate the group of diesel tanks located in the northwest corner of Cracker Asphalt Road loop. It appeared that all four tanks had been removed some time prior to the site visit, and there was no evidence of stained or discolored soil in the area.

At 11:35 a.m. we walked to the northwest corner of the site and located the Native American ceremonial mound that is part of an archaeological research area frequently utilized by the University of Alabama. South of the ceremonial mound is a small, open field that is also part of the research area. The lagoon used by Cracker Asphalt to collect storm water runoff is located directly south of the research field. Mr. Cruise and I evaluated the lagoon, which contained a low volume of water at the time of inspection. We observed an oily sheen on the water in some areas, and there was evidence of stratified asphalt or tar along the interior banks of the lagoon. After evaluating the lagoon, we walked south along the west side of Cracker Asphalt Road loop. In this area, we observed two large bins containing rusted paint cans, fuel cans, and other containers. We also located one of the two former asphalt skimmer trenches, which were located directly west of the former cooling pond. The skimmer trench still contained asphalt, which had not completely solidified.

At 11:45 a.m. we walked towards the southwest corner of the Cracker Asphalt Road loop and observed a dismantled asphalt tank that had been cut into halves. There was pooled asphalt or tar inside both tank halves, and a strong tar-like odor was persistent in the area. There was also a small area of spilled or discarded tar on the ground that appeared to have originated from the dismantled tank. We then met with Mr. John Haddock, who arrived at the site as we were inspecting the dismantled tank. Mr. Haddock stated that he had been responsible for submitting groundwater monitoring reports to ADEM. Mr. Haddock stated that after most of the contamination had been attenuated, he submitted a request to ADEM to discontinue monitoring; Mr. Haddock then ceased groundwater monitoring after not receiving any reply from ADEM. I asked Mr. Haddock the specific functions of the cooling pond and lagoon, and he stated that the cooling pond was a cooling water holding pond used by the facility and that the lagoon was a sediment basin for storm water runoff. Mr. Haddock asked to be forwarded copies of all correspondence with Mr. Wessehoeft and Ms. Smalley.

At 12:30 p.m. Mr. Cruise and I returned to the B&W Heads office to meet with Ms. Smalley, Mr. Wesselhoeft, and Mr. Haddock. We discussed the condition of the site and also the groundwater monitoring reports that ADEM does not currently have on file. I informed the owners and Mr. Haddock that I would submit a request to look through ADEM's archived files, where the missing monitoring reports might be found. Mr. Haddock stated that he would search through his personal files and attempt to locate and forward ADEM the most recent monitoring report.

At 1:00 p.m. Mr. Cruise and I departed the site.

Attachments:

PHOTOGRAPHIC LOG:

For

Cracker Asphalt, Site Reassessment

Cracker Asphalt Road,
Moundville, Tuscaloosa County, Alabama

EPA ID No. AL0000472712

Photograph Date: December 9, 2010

Photo 1	B&W Heads main office; located directly south of the Cracker Asphalt Rd. loop. Photo taken facing southwest.
Photo 2	Former on-site office; facing west from southern end of Cracker Asphalt Rd. loop.
Photo 3	Large storage shed near the southeast corner of the site; facing east from west end of shed.
Photo 4	Tank heads produced by B&W Heads. Manufacturing area is located directly south of the large shed. Photo taken facing southeast.
Photo 5	Drums stored near west end of large shed.
Photo 6	Drums stored near west end of large shed.
Photo 7	North side of large shed, with dirt road leading to the east side of the site. Photo taken facing east.
Photo 8	Dried chunks of asphalt near the north side of the shed.
Photo 9	East side of shed and tank head manufacturing area; facing west.
Photo 10	East side of shed and tank head manufacturing area; facing west.
Photo 11	Small shed near east side of the site, with asphalt tanks in background. Photo taken facing northwest.
Photo 12	Group of asphalt tanks near the southeast corner of Cracker Asphalt Rd. loop. Photo taken facing northwest.
Photo 13	Solidified tank bottoms where one of the former asphalt tanks had been removed. Located in group of tanks near southeast corner of Cracker Asphalt Rd. loop.
Photo 14	Evidence of asphalt or tar leakage from one of the tanks near the southeast corner of Cracker Asphalt Rd. loop.
Photo 15	Area of solidified asphalt or tar on ground near southeast corner of Cracker Asphalt Rd. loop.
Photo 16	Former cooling pond, located in the central area of Cracker Asphalt Rd. loop. Photo taken facing west from east side of loop.
Photo 17	One of several structures located in the former cooling pond area. These may have been used as asphalt skimmers.
Photo 18	Group of drums near south side of former cooling pond area. Photo taken facing east.

Photo 19	Alternate view of asphalt tanks on east side of Cracker Asphalt Rd. loop. Photo taken facing east from center of former cooling pond.
Photo 20	Alternate view of asphalt tanks on east side of Cracker Asphalt Rd. loop. Photo taken facing east from center of former cooling pond.
Photo 21	Broken monitoring well in/near former cooling pond area. Based on old site maps, this appears to be CA-MW4.
Photo 22	Tank near northeast corner of Cracker Asphalt Rd. loop. The tank was on its side and was slowly leaking a tar-like substance.
Photo 23	Group of four asphalt tanks located within the northeast corner of Cracker Asphalt Rd. loop. Photo taken facing north.
Photo 24	Solidified asphalt or tar on ground in area near the four asphalt tanks. Located within the northeast corner of Cracker Asphalt Rd. loop.
Photo 25	Interior view of one of the four tanks within northeast corner of loop. There was a black, viscous liquid inside the tank.
Photo 26	Stained soils near base of asphalt tank. Located in group of tanks within northeast corner of Cracker Asphalt Rd. loop.
Photo 27	Area within northwest corner of Cracker Asphalt Rd. loop where group of four diesel tanks were formerly located. Photo taken facing south.
Photo 28	Native American ceremonial mound near northwest corner of property. Photo taken facing north.
Photo 29	View of Hemphill Bend, Black Warrior River. Photo taken facing north from northwest corner of site.
Photo 30	View of former Southern Resins Company property; facing west from northwest corner of Cracker Asphalt site.
Photo 31	Open area directly south of the Native American ceremonial mound. University of Alabama students use these areas for archaeological research. Photo taken facing southeast.
Photo 32	Monitoring well directly north of former lagoon, south of the archaeological research area. Based on old maps of the site, this appears to be CA-MW1.
Photo 33	View of former lagoon, located on western side of Cracker Asphalt Rd. loop. Photo taken facing south.
Photo 34	Solidified asphalt or tar along the banks of the former Cracker Asphalt lagoon.

Photo 35	One of two bins containing rusted paint cans, fuel cans, and other small containers. Located along the west side of Cracker Asphalt Rd. loop.
Photo 36	One of two bins containing rusted paint cans, fuel cans, and other small containers. Located along the west side of Cracker Asphalt Rd. loop.
Photo 37	Asphalt skimmer located directly west of the former cooling pond area. Photo taken facing east.
Photo 38	Asphalt tank that was recently dismantled. Located near the southwest corner of Cracker Asphalt Rd. loop. Note the presence of asphalt or tar in tank halves.
Photo 39	Spilled asphalt or tar in a small pit near the dismantled asphalt tank.
Photo 40	Southern portion of Cracker Asphalt Rd. loop. Photo taken facing east from southwest corner of loop.

Photo Log for Site Reassessment
Cracker Asphalt
CERCLA ID No. AL0000472712
Tuscaloosa County, Alabama

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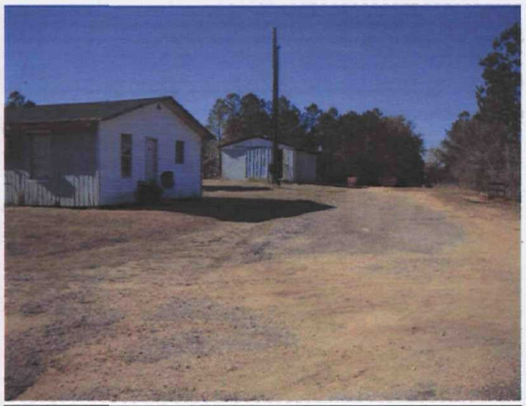

Photo 2: Former on-site office; facing west from southern end of Cracker Asphalt Rd. loop.

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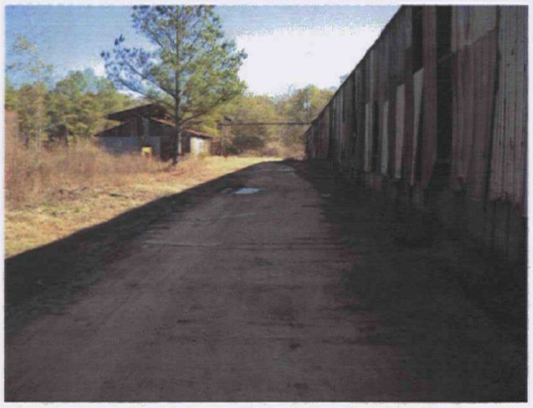

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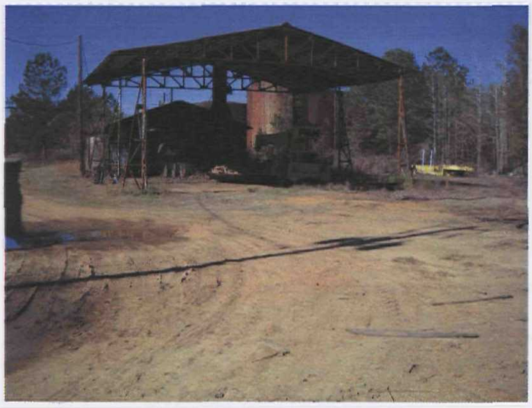

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Photo Log for Site Reassessment
Cracker Asphalt
CERCLA ID No. AL0000472712
Tuscaloosa County, Alabama

Photo 13: Solidified tank bottoms where one of the former asphalt tanks had been removed. Located in group of tanks near southeast corner of Cracker Asphalt Rd. loop.

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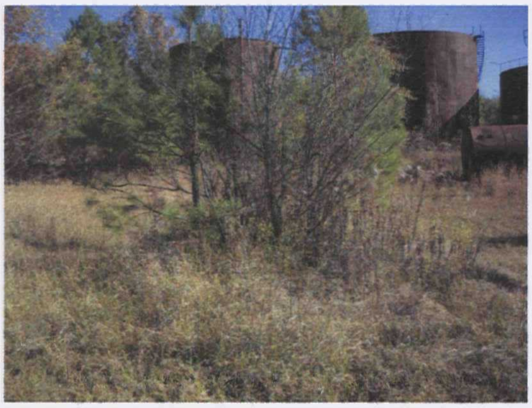

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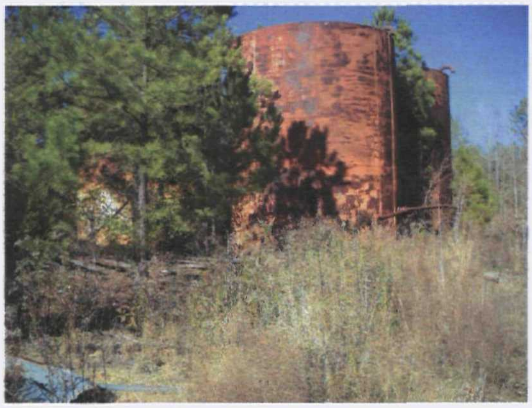

Photo 23: Group of four asphalt tanks located within the northeast corner of Cracker Asphalt Rd. loop. Photo taken facing north.

Photo 24: Solidified asphalt or tar on ground in area near the four asphalt tanks. Located within the northeast corner of Cracker Asphalt Rd. loop.

Photo Log for Site Reassessment
Cracker Asphalt
CERCLA ID No. AL0000472712
Tuscaloosa County, Alabama

Photo 25: Interior view of one of the four tanks within northeast corner of loop. There was a black, viscous liquid inside the tank.

Photo 26: Stained soils near base of asphalt tank. Located in group of tanks within northeast corner of Cracker Asphalt Rd. loop.

Photo 27: Area within northwest corner of Cracker Asphalt Rd. loop where group of four diesel tanks were formerly located. Photo taken facing south.

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